

Engineering Design File

Shielding and Exposure Calculations for V-Tank Waste Process Activities



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ENGINEERING DESIGN FILE

EDF No.: 4604

EDF Rev. No.: 1

Project File No.: 22901

1. Title: Shielding and Exposure Calculations for V-Tank Waste Process Activities				
2. Index Codes: Building/Type TAN-607 SSC ID None Site Area TAN				
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5. Summary: The purpose of this Engineering Design File (EDF) is to document the shielding calculations that estimate exposure rates during processing and treatment of the V-Tank wastes. It was assumed that the maximum exposure rates would come from the sludge. The results are listed in Table 2. Separate exposure calculations were performed for each of the primary geometries: the consolidation tanks, piping, reaction vessel, the processing equipment, and area-shielding materials. In addition, scenarios were run for an individual standing on top of the V-3 and V-9 tanks with the current waste inventory in place. The V-Tank waste will be pumped into two high-integrity consolidation tanks where the waste will be treated and stored until final disposition.				
MicroShield (MS 6) is a shielding code used to model exposures rates in air for the waste storage tanks, treatment equipment, transfer pipes, and concrete shielding. Exposure rates were calculated at contact, 1 ft, 2 ft, 3 ft, and 4 ft for the primary geometries. It was assumed that the worst-case scenario for exposure was pumping the entire 1,880 gal of sludge into one consolidation tank. Also, it was assumed for every other process exposure scenario that sludge would completely fill the volumes of pipes, pumps, reaction vessel, and system processing equipment. This allowed for determining the maximum exposure rate for the different geometries associated with treatment activities.				
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Independent Peer Reviewer (if applicable)	R	N/A		
Approver	A	Richard K. Farnsworth/ Engineering		9/13/04
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ACRONYMS

DOE	Department of Energy
DOE-ID	Department of Energy Idaho Operations Office
EDF	Engineered Design File
EPA	Environmental Protection Agency
INEEL	Idaho National Engineering and Environmental Laboratory
MCP	Management Change Process
MS6	MicroShield 6.02
RPP	Radiation Protection Program
TAN	Test Area North

Shielding and Exposure Calculations for V-Tank Waste Process Activities

1. INTRODUCTION

This EDF develops the dose consequence for an individual(s) performing V-Tank waste process activities at Test Area North (TAN). Personnel will be operating the waste process system at distance from the actual tanks, piping, pumps, and process treatment equipment. The activities addressed here will not affect the public or the environment; therefore, the only consequences discussed are those to the process operators and co-located workers.

2. METHOD

In this analysis, the methodology used to calculate the exposure to a receptor is accomplished by utilizing shielding software. MicroShield 6.02¹ (MS 6) was used to model the exposure rate resulting from direct gamma radiation exposure to an individual. Since there is no anticipated scenario for ingestion or inhalation of V-Tank sludge or liquefied waste, internal exposure is not considered.

Verification and Validation of MS 6:

The MS 6 program is a radiological safety analysis and radiological engineering program that has been used extensively at the Idaho National Engineering and Environmental Laboratory (INEEL). MS 6 has been independently verified and validated for these types of calculations. The MS 6 program and computer information are:

Program Name: MS 6
Version Number: 6.02 (6.02-00061)
Operating System: Microsoft Windows XP, Service Pack 1
Software Configuration and Control Number: 121983
Computer Type: DELL Precision 420 Workstation
CPU Number: 369306.

Microsoft Excel software was used to manipulate and calculate all tabular data representations within this EDF. The calculations performed with Excel can be reproduced and checked by hand. Excel is exempt from qualification per Management Control Procedure (MCP)-550, Section 4.2. The Excel program and computer information are:

Program Name: Excel
Version Number: Microsoft Excel 2000 (9.0.4402 SR-1)
Operating System: Microsoft Windows XP, Service Pack 1
Software Configuration and Control Number: N/A
Computer Type: DELL Precision 420 Workstation
CPU Number: 369306.

3. ASSUMPTIONS

The radionuclide inventory (source term) was taken from the combined V-Tank inventories. The actual values were taken from EDF-3868, "V-Tank Analytical Data: Calculated Averages and Upper Confidence Limits."² The values are listed in Table 1, "V-Tank Source Terms." The sludge volume was

obtained from the conceptual design report for "Ex Situ Chemical Oxidation/Reduction and Stabilization of the V-Tanks at Waste Area Group 1, Operable Unit 1-10."³ The volume was listed in Table 1 of that report. V-Tank capacities and current contents (in gallons) and was listed as 1,880 gal total. The sludge density for each tank inventory was taken from EDF-3868. The sludge densities from each tank were then averaged together for an overall density of 1.02 g/cm³. The source material utilized a custom material file "V123 sludge" (V123.MT5) obtained from the radiological engineering staff. Combining the activity to the total volume of the sludge derived the source term.

The source term geometries were divided into two categories: cylinders and a rectangle. The cylinder geometry included the consolidation tanks, pipes, the reaction vessel, and the V-9 tank with the V-3 tank being the only rectangular geometry (to simulate a horizontal cylinder geometry). The key assumptions associated with the V-3 scenario were that the tank was 18 feet long with a diameter of 10 feet, with the sludge thickness being approximately 0.5 feet and the resulting air gap being the remaining 9.5 feet.

It was assumed that the worst-case scenario for exposure was to have the entire V-tank radionuclide sludge inventory (1,880 gal) pumped into one of the consolidation tanks, essentially creating a double batch. The amount of radionuclide inventory for each geometry was calculated by dividing the specific geometry volume by the 1,880-gal-tank volume, then multiplying the result by the individual radionuclide activities in the 1,880-gal volume, and then summing the results to obtain a geometry total activity. The pipe geometry activity example is shown below. The volume and activity results are listed in Table 1, representing the values for the 1996 sampling activities. Approximately eight years have passed since the samples were analyzed. The activity amounts were decayed in MS 6 for eight years in order to provide a more realistic source term for the shielding calculations.

$$\Sigma[(V_p/V_t) \times A_{\text{tank}}] = A_{\text{total}}$$

Where:

V_p = pipe volume

V_t = tank volume

A_{tank} = activity per nuclide in tank

A_{total} = total activity of all nuclides summed.

Table 1. V-Tank source terms.

Nuclide	Tank 1 Sludge (Ci)	Tank 2 Sludge (Ci)	Tank 3 Sludge (Ci)	Tank 9 Sludge (Ci)	Consolidation Tank 1880 gal (Ci)	Stainless Steel Pipe 10' section (Ci)	Reaction Vessel 600 gal (Ci)
Ag-108m	1.40E-03	1.43E-03	2.07E-03	0.00E+00	4.90E-03	4.26E-06	1.56E-03
Ag-110m	2.46E-03	2.42E-03	3.70E-03	0.00E+00	8.58E-03	7.45E-06	2.74E-03
Am-241	2.71E-02	3.52E-03	1.56E-02	5.33E-03	5.15E-02	4.47E-05	1.64E-02
Ce-144	1.63E-02	1.35E-02	2.94E-02	0.00E+00	5.92E-02	5.14E-05	1.89E-02
Cm-242	9.46E-05	6.21E-06	1.05E-04	0.00E+00	2.05E-04	1.78E-07	6.55E-05
Cm-243	7.98E-03	2.29E-04	4.38E-03	6.16E-04	1.32E-02	1.15E-05	4.21E-03
Cm-244	7.98E-03	2.29E-04	4.38E-03	6.16E-04	1.32E-02	1.15E-05	4.21E-03
Co-58	2.86E-03	2.20E-03	3.67E-03	0.00E+00	8.73E-03	7.58E-06	2.79E-03
Co-60	3.07E-01	3.81E-01	4.08E-01	1.00E+00	2.10E+00	1.82E-03	6.71E-01
Cs-134	1.97E-03	7.78E-04	3.30E-03	0.00E+00	6.04E-03	5.25E-06	1.93E-03
Cs-137	1.11E+01	1.10E+01	1.65E+01	5.95E+00	4.46E+01	3.87E-02	1.42E+01
Eu-152	4.46E-02	2.29E-02	3.98E-02	0.00E+00	1.07E-01	9.32E-05	3.43E-02

Table 1. (continued).

Nuclide	Tank 1 Sludge (Ci)	Tank 2 Sludge (Ci)	Tank 3 Sludge (Ci)	Tank 9 Sludge (Ci)	Consolidation Tank 1880 gal (Ci)	Stainless Steel Pipe 10' section (Ci)	Reaction Vessel 600 gal (Ci)
Eu-154	6.00E-02	3.28E-02	6.84E-02	2.36E-02	1.85E-01	1.61E-04	5.90E-02
Eu-155	5.56E-03	5.67E-03	9.37E-03	0.00E+00	2.06E-02	1.79E-05	6.57E-03
I-129	8.57E-05	9.80E-05	1.53E-04	0.00E+00	3.37E-04	2.92E-07	1.07E-04
Mn-54	1.02E-03	8.25E-04	1.30E-03	0.00E+00	3.15E-03	2.74E-06	1.01E-03
Nb-95	6.30E-03	2.32E-03	6.95E-03	0.00E+00	1.56E-02	1.35E-05	4.97E-03
Ni-63	2.12E+00	1.31E+00	2.08E+00	0.00E+00	5.51E+00	4.78E-03	1.76E+00
Np-237	3.37E-05	3.71E-05	6.46E-05	3.20E-05	1.67E-04	1.45E-07	5.34E-05
Pu-238	2.41E-02	1.12E-02	2.91E-02	2.14E-02	8.57E-02	7.44E-05	2.74E-02
Pu-239	1.10E-02	9.45E-03	1.50E-02	7.75E-03	4.32E-02	3.75E-05	1.38E-02
Pu-240	1.10E-02	9.45E-03	1.50E-02	7.75E-03	4.32E-02	3.75E-05	1.38E-02
Ra-226	7.63E-04	3.48E-03	6.35E-03	0.00E+00	1.06E-02	9.19E-06	3.38E-03
Ru-103	2.36E-02	1.71E-02	3.55E-02	0.00E+00	7.61E-02	6.61E-05	2.43E-02
Ru-106	1.91E-02	1.60E-02	2.90E-02	0.00E+00	6.41E-02	5.56E-05	2.04E-02
Sb-125	7.71E-03	6.27E-03	1.17E-02	0.00E+00	2.57E-02	2.23E-05	8.19E-03
Sr-90	9.74E+00	1.94E+01	4.71E+01	6.82E+00	8.31E+01	7.22E-02	2.65E+01
U-233	6.64E-03	4.59E-03	4.86E-03	1.14E-02	2.75E-02	2.39E-05	8.78E-03
U-234	6.64E-03	4.59E-03	4.86E-03	1.14E-02	2.75E-02	2.39E-05	8.78E-03
U-235	2.01E-04	1.40E-04	1.59E-04	3.75E-04	8.76E-04	7.61E-07	2.80E-04
U-238	1.09E-04	1.26E-04	1.49E-04	8.55E-05	4.69E-04	4.07E-07	1.50E-04
Zn-65	2.57E-03	2.10E-03	3.24E-03	0.00E+00	7.91E-03	6.87E-06	2.53E-03
Zr-95	5.56E-03	4.15E-03	8.02E-03	0.00E+00	1.77E-02	1.54E-05	5.66E-03

3.1 Volume Calculations

The consolidation tank volume was calculated using the standard cylinder volume formula. The tanks are hemispherical at the bottom. To account for this in MS 6, the volume of the tank dome section was added to the volume of the cylinder. The total volume for the tank sludge content was 251.3 ft³ (7.12E6 cm³). The equation below was solved for 'H' to determine the correct geometry for MS 6 for the 1,880-gal volume. The value for H was approximately 3.20 ft (97.5 cm).

$$V = \pi \times R^2 \times H$$

Where:

V = volume

R = tank radius 5 ft (152.4 cm)

H = height of sludge in the tank 3.20 ft (97.5 cm).

The pipe volume was calculated using the standard cylinder volume formula. A pipe length of 10 ft was chosen to give a representative exposure under operational conditions. The volume was considered a sludge-filled solid geometry with no void space internally. The 10-ft length was used to demonstrate that the exposure was uniform along the axis of the pipe due to quadrature calculations in MS 6. The volume of the pipe was 0.22 ft³ (6,230 cm³).

$$V = \pi \times R^2 \times L$$

Where:

V = Volume

R = pipe radius I.D.

1 in. (2.54 cm)

L = length of pipe sludge

10 ft (304.8 cm).

The reaction vessel is essentially a vertical cylinder. Again, the volume was considered a sludge-filled solid geometry with no void space internally. The volume is 600 gal (2.27E6 cm³) utilizing the typical cylinder formula.

$$V = \pi \times R^2 \times H$$

Where:

V = Volume

R = radius of reactor vessel I.D. 27.6 in. (70.10 cm)

H = height of sludge in the tank 57.87 in. (147.0 cm).

The V-9 tank is a vertical cylinder with a pointed cone bottom. The volume was considered a sludge-filled solid geometry with a 2.55 ft internal air gap between the sludge and the top of the tank. The cone volume at the bottom of the tank was added to the cylindrical volume of the tank to facilitate the MS6 standard cylinder geometry. The volume is 320 gal (1.21E6 cm³) utilizing the typical cylinder formula.

$$V = \pi \times R^2 \times H$$

Where:

V = Volume

R = radius of V-9 tank I.D. 21.0 in. (53.3 cm)

H = height of sludge in the tank 53.3 in. (135.33 cm)

The V-3 tank scenario is a rectangular box. This geometry was used to model the horizontal cylindrical tank configuration given that MS6 does not have this capability. The base scenario assumes a 9.02 ft internal air gap between the sludge and the top of the tank. The volume is 652 gal (2.47E6 cm³) utilizing the typical rectangle formula.

$$V = L \times W \times H$$

Where:

V = Volume

L = length of the tank 18 ft (548.64 cm)

W = width of the tank 10 ft (304.8 cm)

H = height of sludge in the tank 5.81 in. (14.75 cm).

3.2 Shielding Materials

The assumed construction materials for the consolidation tanks and the reaction vessel were Type 304L stainless steel and iron respectively. The MS 6 default density value for iron was used for the reaction vessel. The piping material was assumed to be Schedule 40 304L stainless steel. A custom material file was created for determining the density of the material. Values for the makeup of Type 304L stainless steel were obtained from www.Matweb.com.⁴ Standard concrete blocks were used for modeling the shielding for the waste process area activities. The MS 6 default density value for concrete was used. The concrete block dimensions were 2 × 2 × 6 ft. The concrete wall total height was 8 ft. The pump maintenance shield was assumed to be approximately 1.25 in. (3.175 cm) thick and made of standard carbon steel. The MS 6 default density value of iron (7.86 g/cm³) was used for the shield material.

3.3 Exposure Scenarios

There were 12 different exposure scenarios (listed in Table 2). Exposure summaries along with the approximate exposure rates are listed for the different exposure points. The values in Table 2 have been rounded up for ease of reference. The actual values are located in Appendix A.

A shielding sensitivity analysis was performed on different shielding materials for reducing the exposure rate to individuals performing pump or other maintenance activities near the main storage tanks. A gap of six inches between the tank walls and the shielding material was assumed for each of the material sensitivity analyses. The base scenario used was the consolidation tanks 1880-gal geometry. Different shielding materials were placed next to the tank and the exposure rates were calculated with MS 6 for increasing thicknesses of material. The shielding materials analyzed were tungsten, lead, iron, aluminum, and concrete. The exposure rates shown in Table 2 were from the iron sensitivity analysis. The approximate amount of iron required to reduce the exposure rate from 1,610 mR/hr to 124 mR/hr was 1.25 in (3.175 cm).

Table 2. Exposure summaries.

Geometry	Contact (mR/h)	One foot (mR/h)	Two feet (mR/h)	Three feet (mR/h)	Four feet (mR/h)	Ten meters (mR/h)
Consolidation Tanks	1,610	945	565	375	265	9
Top of Consolidation Tank internal air gap	180	160	140	125	110	N/A
2" Pipes (Stainless Steel)	150	25	10	6	4	<1
Reaction Vessel Tank	1860	1033	615	400	280	N/A
Top of V-3 Tank no H ₂ O shield	265	235	205	180	160	N/A
Top of V-3 Tank 1 ft of H ₂ O for shielding	60	55	50	45	40	N/A
Top of V-3 Tank 2 ft of H ₂ O for shielding	10	7	6	5.5	5	N/A
Top of V-9 Tank	310	200	135	100	75	N/A
Top of V-9 Tank with 1.25" of Iron shielding	110	75	50	35	30	N/A
Pump Maint. Shield	125	83	60	45	35	N/A
Concrete Shield around Consolidation Tanks	<1	N/A	N/A	N/A	N/A	N/A
Concrete Shield around Reaction Vessel Tank	<1	N/A	N/A	N/A	N/A	N/A

In all of the scenarios and geometries except the consolidation tanks pump shield, the 2" piping, and the V-3 tank with water shield, the buildup was calculated in the source. Buildup for the V-3 tank, however, was calculated in the water shield at an energy of 0.6 MeV. This region was chosen based upon its proximity to the dose response point and the scattering cross-section dominance of the water. Buildup for the pump shield and the 2" piping was calculated in the metal shields also at an energy of 0.6 MeV. In

these two scenarios the number of mean free paths dominated in the shields rather than the sludge. In the case of the 2" pipe, the stainless steel pipe wall was relatively thick in comparison to the source. The pump shield scenario was similar to the pipe scenario; however, the six inch air gap and consolidation tank wall caused additional scattering which in effect caused the pump shield to act like a beam filter thus hardening the radiation field. The 0.6 MeV photon energy dominated the gamma ray spectrum due to the large proportion of Cs-137 in the sludge.

The buildup for the remaining scenarios, due to Compton scattering of primary photons between 0.1 and 5 Mev, was calculated in the source at an energy of 0.6 MeV for most cases. This region was chosen based upon the number of mean free paths, the thin shield material in comparison to the source material, and the scattering cross-section dominance of the sludge. This model proved to satisfy all geometric parameter constraints associated with the MS 6 point kernel mathematical models and is insensitive to changes in x, y, and z coordinate quadrature. The quadrature inputs were 21, 21, 21 for the x, y, and z coordinates, respectively.

4. CONCLUSIONS

The analysis shows that the exposure to the process operators and co-located workers does not challenge the Department of Energy, Idaho Operations Office (DOE-ID) Order 420.D requirements.⁵ Risk to process operators and co-located workers does not increase or exceed safety requirements. If additional material or activities need to be added to the processing activities, further analysis will be required.

This exposure consequence analysis concludes that these new activities can be conducted safely, and that the equipment and controls implemented by the INEEL Radiation Protection Program (RPP) are adequate to minimize radiation exposure to the process operators and co-located workers. There is no potential radiation exposure to the public or the environment.

5. REFERENCES

1. MicroShield, Version 6.02, Rockville, MD, Grove Engineering, 2003.
2. EDF-3868, "V-Tank Analytical Data: Calculated Averages and Upper Confidence Limits," Rev. 1, D. R. Tyson, December 8, 2003.
3. Conceptual Design Report, "Ex Situ Chemical Oxidation/Reduction and Stabilization of the V-Tanks at Waste Area Group 1, Operable Unit 1-10," INEEL/EXT-03-00438, Project # 22901, June 2003.
4. <http://www.matweb.com/index.asp?ckck=1>.
5. DOE-ID Order 420.D, Rev. 0, "Requirements and Guidance for Safety Analysis," U.S. Department of Energy, Idaho Operations Office, July 17, 2000.

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Rev. 11

ENGINEERING DESIGN FILE

Appendix A
MicroShield v6.02

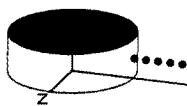
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
DOS File : VTANK Holding vessel 1880 gal decayed 8yr sens.ms6
Run Date: August 23, 2004
Run Time: 2:17:45 PM
Duration : 00:00:38

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: TAN V tank Process
Description: V-tank waste Decayed 8 yrs 1880 gal batch sens @ 1' steps
Geometry: 7 ~ Cylinder Volume - Side Shields



	Source Dimensions		
Height	97.5 cm	3 ft 2.4 in	
Radius	152.4 cm	5 ft 0.0 in	

Dose Points

#	X	Y	Z
# 1	155.89 cm 5 ft 1.4 in	48.8 cm 1 ft 7.2 in	0 cm 0.0 in
# 2	183.8325 cm 6 ft 0.4 in	48.8 cm 1 ft 7.2 in	0 cm 0.0 in
# 3	214.3125 cm 7 ft 0.4 in	48.8 cm 1 ft 7.2 in	0 cm 0.0 in
# 4	244.7925 cm 8 ft 0.4 in	48.768 cm 1 ft 7.2 in	0 cm 0.0 in
# 5	275.2725 cm 9 ft 0.4 in	48.768 cm 1 ft 7.2 in	0 cm 0.0 in
# 6	1153.353 cm 37 ft 10.1 in	48.768 cm 1 ft 7.2 in	0 cm 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	251.235 ft ³	V123 SLUDGE	1.02
Shield 1	.031 ft	304L	8
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm ³
Ac-225	2.0513e-005	7.5899e+005	2.8834e-006	1.0669e-001
Ac-227	1.7357e-008	6.4222e+002	2.4398e-009	9.0274e-005
Ac-228	5.1819e-019	1.9173e-008	7.2840e-020	2.6951e-015
Ag-108	4.3623e-004	1.6141e+007	6.1319e-005	2.2688e+000
Ag-108m	4.6907e-003	1.7355e+008	6.5934e-004	2.4396e+001
Ag-110	3.4418e-008	1.2735e+003	4.8380e-009	1.7901e-004
Ag-110m	2.5878e-006	9.5750e+004	3.6376e-007	1.3459e-002
Am-241	5.0843e-002	1.8812e+009	7.1468e-003	2.6443e+002
Am-243	2.1623e-008	8.0004e+002	3.0394e-009	1.1246e-004
At-217	2.0513e-005	7.5898e+005	2.8834e-006	1.0669e-001
Ba-137m	3.5108e+001	1.2990e+012	4.9349e+000	1.8259e+005
Bi-210	2.3232e-003	8.5959e+007	3.2656e-004	1.2083e+001
Bi-211	1.6870e-008	6.2419e+002	2.3713e-009	8.7739e-005
Bi-212	2.3670e-019	8.7578e-009	3.3271e-020	1.2310e-015
Bi-213	2.0513e-005	7.5897e+005	2.8834e-006	1.0668e-001
Bi-214	1.0561e-002	3.9077e+008	1.4845e-003	5.4928e+001
Ce-144	4.7684e-005	1.7643e+006	6.7027e-006	2.4800e-001
Cm-242	8.3558e-010	3.0917e+001	1.1745e-010	4.3458e-006
Cm-243	1.0866e-002	4.0205e+008	1.5274e-003	5.6513e+001
Cm-244	9.7184e-003	3.5958e+008	1.3661e-003	5.0544e+001
Co-58	3.2896e-015	1.2172e-004	4.6241e-016	1.7109e-011

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK Holding vessel 1880 gal decayed 8yr sens.ms6
Run Date: August 23, 2004
Run Time: 2:17:45 PM
Duration : 00:00:38

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Co-60	7.3339e-001	2.7135e+010	1.0309e-001	3.8143e+003
Cs-134	4.1032e-004	1.5182e+007	5.7676e-005	2.1340e+000
Cs-137	3.7112e+001	1.3731e+012	5.2166e+000	1.9301e+005
Eu-152	7.1172e-002	2.6334e+009	1.0004e-002	3.7016e+002
Eu-154	9.8516e-002	3.6451e+009	1.3848e-002	5.1237e+002
Eu-155	6.7350e-003	2.4919e+008	9.4670e-004	3.5028e+001
Fr-221	2.0513e-005	7.5898e+005	2.8834e-006	1.0669e-001
Fr-223	2.3953e-010	8.8626e+000	3.3669e-011	1.2458e-006
Gd-152	1.2315e-015	4.5564e-005	1.7310e-016	6.4046e-012
I-129	3.3700e-004	1.2469e+007	4.7370e-005	1.7527e+000
Mn-54	4.8457e-006	1.7929e+005	6.8114e-007	2.5202e-002
Nb-95	7.1267e-016	2.6369e-005	1.0018e-016	3.7065e-012
Nb-95m	2.7331e-018	1.0112e-007	3.8417e-019	1.4214e-014
Ni-63	5.2131e+000	1.9288e+011	7.3277e-001	2.7113e+004
Np-237	1.6713e-004	6.1839e+006	2.3493e-005	8.6924e-001
Np-239	2.1600e-008	7.9920e+002	3.0362e-009	1.1234e-004
Pa-231	1.4819e-007	5.4829e+003	2.0830e-008	7.7071e-004
Pa-233	1.6713e-004	6.1838e+006	2.3493e-005	8.6923e-001
Pa-234	7.5040e-007	2.7765e+004	1.0548e-007	3.9027e-003
Pa-234m	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000
Pb-209	2.0511e-005	7.5892e+005	2.8832e-006	1.0668e-001
Pb-210	2.3283e-003	8.6146e+007	3.2727e-004	1.2109e+001
Pb-211	1.6870e-008	6.2419e+002	2.3713e-009	8.7739e-005
Pb-212	2.3672e-019	8.7585e-009	3.3274e-020	1.2311e-015
Pb-214	1.0561e-002	3.9077e+008	1.4845e-003	5.4928e+001
Po-210	2.1806e-003	8.0681e+007	3.0651e-004	1.1341e+001
Po-211	4.6055e-011	1.7040e+000	6.4737e-012	2.3953e-007
Po-212	1.5165e-019	5.6111e-009	2.1317e-020	7.8873e-016
Po-213	2.0070e-005	7.4258e+005	2.8211e-006	1.0438e-001
Po-214	1.0559e-002	3.9069e+008	1.4842e-003	5.4917e+001
Po-215	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Po-216	2.3689e-019	8.7649e-009	3.3298e-020	1.2320e-015
Po-218	1.0563e-002	3.9085e+008	1.4848e-003	5.4939e+001
Pr-144	4.7686e-005	1.7644e+006	6.7029e-006	2.4801e-001
Pr-144m	6.8189e-007	2.5230e+004	9.5850e-008	3.5465e-003
Pu-238	8.0453e-002	2.9768e+009	1.1309e-002	4.1843e+002
Pu-239	4.3193e-002	1.5981e+009	6.0714e-003	2.2464e+002
Pu-240	4.3173e-002	1.5974e+009	6.0686e-003	2.2454e+002
Ra-223	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Ra-224	2.3689e-019	8.7650e-009	3.3298e-020	1.2320e-015
Ra-225	2.0616e-005	7.6278e+005	2.8978e-006	1.0722e-001
Ra-226	1.0563e-002	3.9084e+008	1.4848e-003	5.4939e+001
Ra-228	5.1837e-019	1.9180e-008	7.2865e-020	2.6960e-015
Rh-103m	3.3666e-024	1.2456e-013	4.7322e-025	1.7509e-020
Rh-106	2.6177e-004	9.6853e+006	3.6795e-005	1.3614e+000
Rn-219	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Rn-220	2.3689e-019	8.7649e-009	3.3298e-020	1.2320e-015
Rn-222	1.0563e-002	3.9085e+008	1.4848e-003	5.4939e+001
Ru-103	3.3721e-024	1.2477e-013	4.7400e-025	1.7538e-020
Ru-106	2.6177e-004	9.6853e+006	3.6795e-005	1.3614e+000
Sb-125	3.4716e-003	1.2845e+008	4.8799e-004	1.8056e+001
Sr-90	6.8454e+001	2.5328e+012	9.6222e+000	3.5602e+005
Te-125m	8.5071e-004	3.1476e+007	1.1958e-004	4.4245e+000
Th-227	1.6817e-008	6.2222e+002	2.3638e-009	8.7462e-005
Th-228	2.3833e-019	8.8184e-009	3.3501e-020	1.2396e-015
Th-229	2.0767e-005	7.6839e+005	2.9191e-006	1.0801e-001
Th-230	1.9804e-006	7.3275e+004	2.7837e-007	1.0300e-002
Th-231	8.7600e-004	3.2412e+007	1.2313e-004	4.5560e+000
Th-232	2.0185e-018	7.4684e-008	2.8373e-019	1.0498e-014
Th-234	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000

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<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
TI-207	1.6824e-008	6.2249e+002	2.3648e-009	8.7499e-005
TI-208	8.5046e-020	3.1467e-009	1.1954e-020	4.4232e-016
TI-209	4.4308e-007	1.6394e+004	6.2281e-008	2.3044e-003
U-233	2.7499e-002	1.0175e+009	3.8654e-003	1.4302e+002
U-234	2.7501e-002	1.0175e+009	3.8657e-003	1.4303e+002
U-235	8.7600e-004	3.2412e+007	1.2313e-004	4.5560e+000
U-236	1.0228e-008	3.7842e+002	1.4376e-009	5.3192e-005
U-238	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000
Y-90	6.8471e+001	2.5334e+012	9.6246e+000	3.5611e+005
Zn-65	1.9912e-006	7.3675e+004	2.7989e-007	1.0356e-002
Zr-95	3.2238e-016	1.1928e-005	4.5315e-017	1.6767e-012

Buildup
The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (5.11e+00,1.60e+00,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.230e+04	5.793e-223	8.100e-29	4.969e-224	6.947e-30
0.02	1.141e+08	3.517e-99	3.250e-25	1.218e-100	1.126e-26
0.03	7.667e+10	1.900e-29	1.405e-21	1.883e-31	1.393e-23
0.04	2.041e+10	1.236e-12	4.600e-11	5.465e-15	2.035e-13
0.05	6.026e+08	1.175e-07	7.212e-06	3.130e-10	1.921e-08
0.06	6.855e+08	1.347e-04	8.763e-03	2.676e-07	1.741e-05
0.08	1.851e+08	1.287e-02	5.645e-01	2.037e-05	8.933e-04
0.1	2.481e+09	1.801e+00	5.139e+01	2.756e-03	7.862e-02
0.15	7.083e+06	4.581e-02	6.745e-01	7.543e-05	1.111e-03
0.2	5.741e+08	8.887e+00	9.342e+01	1.569e-02	1.649e-01
0.3	8.558e+08	3.292e+01	2.388e+02	6.244e-02	4.530e-01
0.4	5.377e+08	3.637e+01	2.111e+02	7.087e-02	4.113e-01
0.5	4.533e+07	4.675e+00	2.307e+01	9.176e-03	4.528e-02
0.6	1.170e+12	1.694e+05	7.380e+05	3.307e+02	1.440e+03
0.8	2.099e+09	5.181e+02	1.879e+03	9.855e-01	3.574e+00
1.0	2.951e+10	1.101e+04	3.511e+04	2.029e+01	6.471e+01
1.5	2.924e+10	2.292e+04	5.920e+04	3.856e+01	9.961e+01
2.0	1.046e+08	1.362e+02	3.118e+02	2.106e-01	4.822e-01
3.0	3.140e-09	8.078e-15	1.594e-14	1.096e-17	2.163e-17
TOTALS:	1.334e+12	2.041e+05	8.351e+05	3.909e+02	1.610e+03

Results - Dose Point # 2 - (6.03125,1.60e+00,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.230e+04	4.794e-194	4.395e-29	4.112e-195	3.769e-30
0.02	1.141e+08	5.185e-87	1.763e-25	1.796e-88	6.108e-27
0.03	7.667e+10	2.473e-26	7.624e-22	2.450e-28	7.556e-24
0.04	2.041e+10	1.106e-11	3.583e-10	4.892e-14	1.585e-12
0.05	6.026e+08	2.143e-07	1.136e-05	5.708e-10	3.026e-08
0.06	6.855e+08	1.429e-04	8.272e-03	2.839e-07	1.643e-05
0.08	1.851e+08	1.015e-02	4.227e-01	1.606e-05	6.690e-04
0.1	2.481e+09	1.332e+00	3.723e+01	2.037e-03	5.695e-02

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<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
0.15	7.083e+06	3.244e-02	4.572e-01	5.342e-05	7.528e-04
0.2	5.741e+08	6.161e+00	6.033e+01	1.087e-02	1.065e-01
0.3	8.558e+08	2.225e+01	1.475e+02	4.221e-02	2.797e-01
0.4	5.377e+08	2.417e+01	1.274e+02	4.709e-02	2.483e-01
0.5	4.533e+07	3.063e+00	1.372e+01	6.012e-03	2.693e-02
0.6	1.170e+12	1.097e+05	4.340e+05	2.140e+02	8.472e+02
0.8	2.099e+09	3.284e+02	1.086e+03	6.246e-01	2.065e+00
1.0	2.951e+10	6.854e+03	2.003e+04	1.263e+01	3.692e+01
1.5	2.924e+10	1.380e+04	3.303e+04	2.322e+01	5.557e+01
2.0	1.046e+08	8.020e+01	1.717e+02	1.240e-01	2.655e-01
3.0	3.140e-09	4.634e-15	8.666e-15	6.286e-18	1.176e-17
TOTALS:	1.334e+12	1.308e+05	4.887e+05	2.507e+02	9.428e+02

Results - Dose Point # 3 - (7.03125,1.60e+00,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
0.015	6.230e+04	1.362e-193	2.820e-29	1.168e-194	2.418e-30
0.02	1.141e+08	5.635e-87	1.131e-25	1.952e-88	3.919e-27
0.03	7.667e+10	1.701e-26	4.892e-22	1.686e-28	4.848e-24
0.04	2.041e+10	8.937e-12	2.924e-10	3.952e-14	1.293e-12
0.05	6.026e+08	1.879e-07	9.934e-06	5.004e-10	2.646e-08
0.06	6.855e+08	1.197e-04	6.793e-03	2.378e-07	1.349e-05
0.08	1.851e+08	7.763e-03	3.109e-01	1.228e-05	4.920e-04
0.1	2.481e+09	9.565e-01	2.515e+01	1.463e-03	3.848e-02
0.15	7.083e+06	2.154e-02	2.845e-01	3.547e-05	4.685e-04
0.2	5.741e+08	3.977e+00	3.674e+01	7.019e-03	6.485e-02
0.3	8.558e+08	1.404e+01	8.864e+01	2.664e-02	1.682e-01
0.4	5.377e+08	1.508e+01	7.628e+01	2.939e-02	1.486e-01
0.5	4.533e+07	1.898e+00	8.194e+00	3.725e-03	1.608e-02
0.6	1.170e+12	6.758e+04	2.589e+05	1.319e+02	5.053e+02
0.8	2.099e+09	2.008e+02	6.465e+02	3.820e-01	1.230e+00
1.0	2.951e+10	4.169e+03	1.192e+04	7.685e+00	2.198e+01
1.5	2.924e+10	8.329e+03	1.966e+04	1.401e+01	3.308e+01
2.0	1.046e+08	4.823e+01	1.023e+02	7.459e-02	1.582e-01
3.0	3.140e-09	2.781e-15	5.179e-15	3.773e-18	7.026e-18
TOTALS:	1.334e+12	8.036e+04	2.914e+05	1.541e+02	5.622e+02

Results - Dose Point # 4 - (8.03125,1.6,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
0.015	6.230e+04	1.284e-193	2.000e-29	1.101e-194	1.715e-30
0.02	1.141e+08	4.415e-87	8.024e-26	1.529e-88	2.779e-27
0.03	7.667e+10	1.429e-26	3.469e-22	1.416e-28	3.438e-24
0.04	2.041e+10	7.882e-12	2.572e-10	3.486e-14	1.138e-12
0.05	6.026e+08	1.551e-07	8.133e-06	4.131e-10	2.166e-08
0.06	6.855e+08	9.419e-05	5.267e-03	1.871e-07	1.046e-05
0.08	1.851e+08	5.665e-03	2.207e-01	8.965e-06	3.492e-04
0.1	2.481e+09	6.708e-01	1.718e+01	1.026e-03	2.628e-02
0.15	7.083e+06	1.459e-02	1.886e-01	2.402e-05	3.106e-04
0.2	5.741e+08	2.664e+00	2.424e+01	4.702e-03	4.279e-02
0.3	8.558e+08	9.338e+00	5.848e+01	1.771e-02	1.109e-01
0.4	5.377e+08	1.000e+01	5.036e+01	1.949e-02	9.812e-02

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<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.5	4.533e+07	1.257e+00	5.414e+00	2.467e-03	1.063e-02
0.6	1.170e+12	4.473e+04	1.712e+05	8.731e+01	3.341e+02
0.8	2.099e+09	1.328e+02	4.281e+02	2.527e-01	8.142e-01
1.0	2.951e+10	2.758e+03	7.904e+03	5.084e+00	1.457e+01
1.5	2.924e+10	5.514e+03	1.307e+04	9.278e+00	2.198e+01
2.0	1.046e+08	3.197e+01	6.815e+01	4.945e-02	1.054e-01
3.0	3.140e-09	1.849e-15	3.462e-15	2.508e-18	4.697e-18
TOTALS:	1.334e+12	5.319e+04	1.928e+05	1.020e+02	3.719e+02

Results - Dose Point # 5 - (9.03125,1.6,0) ft					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.230e+04	1.073e-193	1.506e-29	9.202e-195	1.291e-30
0.02	1.141e+08	3.530e-87	6.042e-26	1.223e-88	2.093e-27
0.03	7.667e+10	1.277e-26	2.612e-22	1.266e-28	2.589e-24
0.04	2.041e+10	6.702e-12	2.180e-10	2.964e-14	9.640e-13
0.05	6.026e+08	1.249e-07	6.509e-06	3.328e-10	1.734e-08
0.06	6.855e+08	7.288e-05	4.028e-03	1.448e-07	8.000e-06
0.08	1.851e+08	4.179e-03	1.609e-01	6.614e-06	2.545e-04
0.1	2.481e+09	4.855e-01	1.229e+01	7.428e-04	1.881e-02
0.15	7.083e+06	1.039e-02	1.339e-01	1.711e-05	2.205e-04
0.2	5.741e+08	1.891e+00	1.721e+01	3.337e-03	3.037e-02
0.3	8.558e+08	6.617e+00	4.152e+01	1.255e-02	7.876e-02
0.4	5.377e+08	7.089e+00	3.577e+01	1.381e-02	6.970e-02
0.5	4.533e+07	8.908e-01	3.848e+00	1.749e-03	7.553e-03
0.6	1.170e+12	3.171e+04	1.217e+05	6.189e+01	2.376e+02
0.8	2.099e+09	9.421e+01	3.047e+02	1.792e-01	5.796e-01
1.0	2.951e+10	1.957e+03	5.632e+03	3.608e+00	1.038e+01
1.5	2.924e+10	3.920e+03	9.332e+03	6.595e+00	1.570e+01
2.0	1.046e+08	2.276e+01	4.877e+01	3.520e-02	7.542e-02
3.0	3.140e-09	1.320e-15	2.486e-15	1.791e-18	3.373e-18
TOTALS:	1.334e+12	3.772e+04	1.372e+05	7.234e+01	2.645e+02

Results - Dose Point # 6 - (3.78e+01,1.6,0) ft					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.230e+04	2.691e-195	7.370e-31	2.308e-196	6.322e-32
0.02	1.141e+08	1.847e-88	2.957e-27	6.399e-90	1.024e-28
0.03	7.667e+10	6.536e-28	1.279e-23	6.477e-30	1.267e-25
0.04	2.041e+10	2.649e-13	8.586e-12	1.171e-15	3.797e-14
0.05	6.026e+08	4.282e-09	2.226e-07	1.141e-11	5.931e-10
0.06	6.855e+08	2.309e-06	1.284e-04	4.586e-09	2.550e-07
0.08	1.851e+08	1.247e-04	4.952e-03	1.973e-07	7.837e-06
0.1	2.481e+09	1.426e-02	3.819e-01	2.181e-05	5.843e-04
0.15	7.083e+06	3.060e-04	4.300e-03	5.039e-07	7.081e-06
0.2	5.741e+08	5.632e-02	5.617e-01	9.940e-05	9.913e-04
0.3	8.558e+08	2.010e-01	1.377e+00	3.813e-04	2.612e-03
0.4	5.377e+08	2.186e-01	1.198e+00	4.259e-04	2.335e-03
0.5	4.533e+07	2.780e-02	1.299e-01	5.456e-05	2.550e-04
0.6	1.170e+12	9.994e+02	4.136e+03	1.951e+00	8.074e+00
0.8	2.099e+09	3.019e+00	1.047e+01	5.742e-03	1.992e-02
1.0	2.951e+10	6.355e+01	1.953e+02	1.171e-01	3.601e-01

ENGINEERING DESIGN FILE

Page : 6
DOS File : VTANK Holding vessel 1880 gal decayed 8yr sens.ms6
Run Date: August 23, 2004
Run Time: 2:17:45 PM
Duration : 00:00:38

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>		<u>Exposure Rate</u>	
		<u>MeV/cm²/sec</u>	<u>No Buildup</u>	<u>MeV/cm²/sec</u>	<u>No Buildup</u>
1.5	2.924e+10	1.306e+02	3.301e+02	2.197e-01	5.554e-01
2.0	1.046e+08	7.730e-01	1.752e+00	1.195e-03	2.709e-03
3.0	3.140e-09	4.609e-17	9.129e-17	6.253e-20	1.239e-19
TOTALS:	1.334e+12	1.198e+03	4.678e+03	2.296e+00	9.019e+00

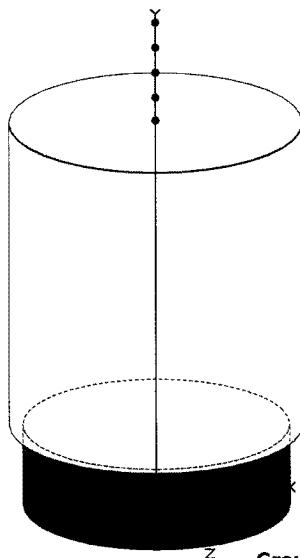
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
 DOS File : VTANK Consolidation tank 1880 gal decayed 8yr top no shiel
 Run Date: August 24, 2004
 Run Time: 11:24:19 AM
 Duration : 00:00:02

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: TAN V tank Process
Description: Waste Decayed 8 yrs 1880 gal w/o shielding @cont, 1,2,3,4 ft
Geometry: 8 - Cylinder Volume - End Shields



		Source Dimensions	
	Height	97.5 cm	3 ft 2.4 in
	Radius	152.4 cm	5 ft 0.0 in

Dose Points			
#	X	Y	Z
# 1	0 cm	468.493 cm	0 cm
	0.0 in	15 ft 4.4 in	0.0 in
# 2	0 cm	496.433 cm	0 cm
	0.0 in	16 ft 3.4 in	0.0 in
# 3	0 cm	526.913 cm	0 cm
	0.0 in	17 ft 3.4 in	0.0 in
# 4	0 cm	557.393 cm	0 cm
	0.0 in	18 ft 3.4 in	0.0 in
# 5	0 cm	587.873 cm	0 cm
	0.0 in	19 ft 3.4 in	0.0 in

Shields			
<u>Shield Name</u>	<u>Dimension</u>	<u>Material</u>	<u>Density</u>
Source	251.235 ft ³	V123 SLUDGE	1.02
Shield 1	12.057 ft	Air	0.00122
Shield 2	.031 ft	304L	8
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25

Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Ac-225	2.0513e-005	7.5899e+005	2.8834e-006	1.0669e-001
Ac-227	1.7357e-008	6.4222e+002	2.4398e-009	9.0274e-005
Ac-228	5.1819e-019	1.9173e-008	7.2840e-020	2.6951e-015
Ag-108	4.3623e-004	1.6141e+007	6.1319e-005	2.2688e+000
Ag-108m	4.6907e-003	1.7355e+008	6.5934e-004	2.4396e+001
Ag-110	3.4418e-008	1.2735e+003	4.8380e-009	1.7901e-004
Ag-110m	2.5878e-006	9.5750e+004	3.6376e-007	1.3459e-002
Am-241	5.0843e-002	1.8812e+009	7.1468e-003	2.6443e+002
Am-243	2.1623e-008	8.0004e+002	3.0394e-009	1.1246e-004
At-217	2.0513e-005	7.5898e+005	2.8834e-006	1.0669e-001
Ba-137m	3.5108e+001	1.2990e+012	4.9349e+000	1.8259e+005
Bi-210	2.3232e-003	8.5959e+007	3.2656e-004	1.2083e+001
Bi-211	1.6870e-008	6.2419e+002	2.3713e-009	8.7739e-005
Bi-212	2.3670e-019	8.7578e-009	3.3271e-020	1.2310e-015
Bi-213	2.0513e-005	7.5897e+005	2.8834e-006	1.0668e-001
Bi-214	1.0561e-002	3.9077e+008	1.4845e-003	5.4928e+001
Ce-144	4.7684e-005	1.7643e+006	6.7027e-006	2.4800e-001
Cm-242	8.3558e-010	3.0917e+001	1.1745e-010	4.3458e-006
Cm-243	1.0866e-002	4.0205e+008	1.5274e-003	5.6513e+001
Cm-244	9.7184e-003	3.5958e+008	1.3661e-003	5.0544e+001
Co-58	3.2896e-015	1.2172e-004	4.6241e-016	1.7109e-011
Co-60	7.3339e-001	2.7135e+010	1.0309e-001	3.8143e+003
Cs-134	4.1032e-004	1.5182e+007	5.7676e-005	2.1340e+000

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK Consolidation tank 1880 gal decayed 8yr top no shiel
Run Date: August 24, 2004
Run Time: 11:24:19 AM
Duration : 00:00:02

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Cs-137	3.7112e+001	1.3731e+012	5.2166e+000	1.9301e+005
Eu-152	7.1172e-002	2.6334e+009	1.0004e-002	3.7016e+002
Eu-154	9.8516e-002	3.6451e+009	1.3848e-002	5.1237e+002
Eu-155	6.7350e-003	2.4919e+008	9.4670e-004	3.5028e+001
Fr-221	2.0513e-005	7.5898e+005	2.8834e-006	1.0669e-001
Fr-223	2.3953e-010	8.8626e+000	3.3669e-011	1.2458e-006
Gd-152	1.2315e-015	4.5564e-005	1.7310e-016	6.4046e-012
I-129	3.3700e-004	1.2469e+007	4.7370e-005	1.7527e+000
Mn-54	4.8457e-006	1.7929e+005	6.8114e-007	2.5202e-002
Nb-95	7.1267e-016	2.6369e-005	1.0018e-016	3.7065e-012
Nb-95m	2.7331e-018	1.0112e-007	3.8417e-019	1.4214e-014
Ni-63	5.2131e+000	1.9288e+011	7.3277e-001	2.7113e+004
Np-237	1.6713e-004	6.1839e+006	2.3493e-005	8.6924e-001
Np-239	2.1600e-008	7.9920e+002	3.0362e-009	1.1234e-004
Pa-231	1.4819e-007	5.4829e+003	2.0830e-008	7.7071e-004
Pa-233	1.6713e-004	6.1838e+006	2.3493e-005	8.6923e-001
Pa-234	7.5040e-007	2.7765e+004	1.0548e-007	3.9027e-003
Pa-234m	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000
Pb-209	2.0511e-005	7.5892e+005	2.8832e-006	1.0668e-001
Pb-210	2.3283e-003	8.6146e+007	3.2727e-004	1.2109e+001
Pb-211	1.6870e-008	6.2419e+002	2.3713e-009	8.7739e-005
Pb-212	2.3672e-019	8.7585e-009	3.3274e-020	1.2311e-015
Pb-214	1.0561e-002	3.9077e+008	1.4845e-003	5.4928e+001
Po-210	2.1806e-003	8.0681e+007	3.0651e-004	1.1341e+001
Po-211	4.6055e-011	1.7040e+000	6.4737e-012	2.3953e-007
Po-212	1.5165e-019	5.6111e-009	2.1317e-020	7.8873e-016
Po-213	2.0070e-005	7.4258e+005	2.8211e-006	1.0438e-001
Po-214	1.0559e-002	3.9069e+008	1.4842e-003	5.4917e+001
Po-215	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Po-216	2.3689e-019	8.7649e-009	3.3298e-020	1.2320e-015
Po-218	1.0563e-002	3.9085e+008	1.4848e-003	5.4939e+001
Pr-144	4.7002e-005	1.7391e+006	6.6068e-006	2.4445e-001
Pu-238	8.0453e-002	2.9768e+009	1.1309e-002	4.1843e+002
Pu-239	4.3193e-002	1.5981e+009	6.0714e-003	2.2464e+002
Pu-240	4.3173e-002	1.5974e+009	6.0686e-003	2.2454e+002
Ra-223	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Ra-224	2.3689e-019	8.7650e-009	3.3298e-020	1.2320e-015
Ra-225	2.0616e-005	7.6278e+005	2.8978e-006	1.0722e-001
Ra-226	1.0563e-002	3.9084e+008	1.4848e-003	5.4939e+001
Ra-228	5.1837e-019	1.9180e-008	7.2865e-020	2.6960e-015
Rh-103m	3.3666e-024	1.2456e-013	4.7322e-025	1.7509e-020
Rh-106	2.6177e-004	9.6853e+006	3.6795e-005	1.3614e+000
Rn-219	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Rn-220	2.3689e-019	8.7649e-009	3.3298e-020	1.2320e-015
Rn-222	1.0563e-002	3.9085e+008	1.4848e-003	5.4939e+001
Ru-103	3.3721e-024	1.2477e-013	4.7400e-025	1.7538e-020
Ru-106	2.6177e-004	9.6853e+006	3.6795e-005	1.3614e+000
Sb-125	3.4716e-003	1.2845e+008	4.8799e-004	1.8056e+001
Sr-90	6.8454e+001	2.5328e+012	9.6222e+000	3.5602e+005
Te-125m	8.5071e-004	3.1476e+007	1.1958e-004	4.4245e+000
Th-227	1.6817e-008	6.2222e+002	2.3638e-009	8.7462e-005
Th-228	2.3833e-019	8.8184e-009	3.3501e-020	1.2396e-015
Th-229	2.0767e-005	7.6839e+005	2.9191e-006	1.0801e-001
Th-230	1.9804e-006	7.3275e+004	2.7837e-007	1.0300e-002
Th-231	8.7600e-004	3.2412e+007	1.2313e-004	4.5560e+000
Th-232	2.0185e-018	7.4684e-008	2.8373e-019	1.0498e-014
Th-234	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000
Tl-207	1.6824e-008	6.2249e+002	2.3648e-009	8.7499e-005
Tl-208	8.5046e-020	3.1467e-009	1.1954e-020	4.4232e-016
Tl-209	4.4308e-007	1.6394e+004	6.2281e-008	2.3044e-003

ENGINEERING DESIGN FILE

Page : 3
 DOS File : VTANK Consolidation tank 1880 gal decayed 8yr top no shiel
 Run Date: August 24, 2004
 Run Time: 11:24:19 AM
 Duration : 00:00:02

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
U-233	2.7499e-002	1.0175e+009	3.8654e-003	1.4302e+002
U-234	2.7501e-002	1.0175e+009	3.8657e-003	1.4303e+002
U-235	8.7600e-004	3.2412e+007	1.2313e-004	4.5560e+000
U-236	1.0228e-008	3.7842e+002	1.4376e-009	5.3192e-005
U-238	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000
Y-90	6.8454e+001	2.5328e+012	9.6222e+000	3.5602e+005
Zn-65	1.9912e-006	7.3675e+004	2.7989e-007	1.0356e-002
Zr-95	3.2238e-016	1.1928e-005	4.5315e-017	1.6767e-012

Buildup
The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (0,1.54e+01,0) ft

<u>Energy MeV</u>	<u>Activity photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>No Buildup</u>	<u>With Buildup</u>	<u>mR/hr</u>
0.015	6.230e+04	2.434e-193	5.236e-30	2.087e-194	4.491e-31
0.02	1.141e+08	5.799e-87	2.101e-26	2.009e-88	7.278e-28
0.03	7.667e+10	2.057e-26	9.085e-23	2.038e-28	9.004e-25
0.04	2.041e+10	1.041e-11	3.381e-10	4.604e-14	1.495e-12
0.05	6.026e+08	1.763e-07	9.055e-06	4.698e-10	2.412e-08
0.06	6.855e+08	9.138e-05	4.886e-03	1.815e-07	9.704e-06
0.08	1.851e+08	4.341e-03	1.563e-01	6.869e-06	2.473e-04
0.1	2.481e+09	4.480e-01	1.041e+01	6.854e-04	1.593e-02
0.15	7.083e+06	8.405e-03	9.894e-02	1.384e-05	1.629e-04
0.2	5.741e+08	1.459e+00	1.221e+01	2.575e-03	2.155e-02
0.3	8.558e+08	4.922e+00	2.873e+01	9.336e-03	5.451e-02
0.4	5.377e+08	5.183e+00	2.453e+01	1.010e-02	4.780e-02
0.5	4.533e+07	6.443e-01	2.625e+00	1.265e-03	5.153e-03
0.6	1.170e+12	2.274e+04	8.274e+04	4.439e+01	1.615e+02
0.8	2.099e+09	6.675e+01	2.058e+02	1.270e-01	3.914e-01
1.0	2.951e+10	1.374e+03	3.784e+03	2.533e+00	6.974e+00
1.5	2.924e+10	2.707e+03	6.191e+03	4.554e+00	1.042e+01
2.0	1.046e+08	1.555e+01	3.199e+01	2.404e-02	4.946e-02
3.0	3.140e-09	8.869e-16	1.598e-15	1.203e-18	2.168e-18
TOTALS:	1.334e+12	2.692e+04	9.303e+04	5.165e+01	1.795e+02

Results - Dose Point # 2 - (0,1.63e+01,0) ft

<u>Energy MeV</u>	<u>Activity photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>No Buildup</u>	<u>With Buildup</u>	<u>mR/hr</u>
0.015	6.230e+04	2.310e-193	4.634e-30	1.981e-194	3.975e-31
0.02	1.141e+08	5.657e-87	1.859e-26	1.960e-88	6.441e-28
0.03	7.667e+10	2.021e-26	8.039e-23	2.003e-28	7.968e-25
0.04	2.041e+10	9.916e-12	3.215e-10	4.386e-14	1.422e-12
0.05	6.026e+08	1.629e-07	8.337e-06	4.340e-10	2.221e-08
0.06	6.855e+08	8.285e-05	4.411e-03	1.646e-07	8.762e-06
0.08	1.851e+08	3.868e-03	1.388e-01	6.121e-06	2.196e-04
0.1	2.481e+09	3.966e-01	9.195e+00	6.067e-04	1.407e-02
0.15	7.083e+06	7.405e-03	8.715e-02	1.219e-05	1.435e-04
0.2	5.741e+08	1.284e+00	1.075e+01	2.266e-03	1.898e-02
0.3	8.558e+08	4.330e+00	2.531e+01	8.214e-03	4.801e-02

ENGINEERING DESIGN FILE

Page : 4
 DOS File : VTANK Consolidation tank 1880 gal decayed 8yr top no shiel
 Run Date: August 24, 2004
 Run Time: 11:24:19 AM
 Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.4	5.377e+08	4.560e+00	2.161e+01	8.886e-03	4.211e-02
0.5	4.533e+07	5.669e-01	2.313e+00	1.113e-03	4.541e-03
0.6	1.170e+12	2.002e+04	7.292e+04	3.907e+01	1.423e+02
0.8	2.099e+09	5.876e+01	1.814e+02	1.118e-01	3.451e-01
1.0	2.951e+10	1.210e+03	3.336e+03	2.230e+00	6.150e+00
1.5	2.924e+10	2.385e+03	5.462e+03	4.012e+00	9.189e+00
2.0	1.046e+08	1.370e+01	2.823e+01	2.119e-02	4.365e-02
3.0	3.140e-09	7.822e-16	1.411e-15	1.061e-18	1.914e-18
TOTALS:	1.334e+12	2.369e+04	8.200e+04	4.546e+01	1.582e+02

Results - Dose Point # 3 - (0,1.73e+01,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.230e+04	2.182e-193	4.092e-30	1.872e-194	3.510e-31
0.02	1.141e+08	5.507e-87	1.642e-26	1.908e-88	5.687e-28
0.03	7.667e+10	1.976e-26	7.099e-23	1.958e-28	7.035e-25
0.04	2.041e+10	9.355e-12	3.028e-10	4.138e-14	1.339e-12
0.05	6.026e+08	1.491e-07	7.608e-06	3.973e-10	2.027e-08
0.06	6.855e+08	7.453e-05	3.954e-03	1.480e-07	7.853e-06
0.08	1.851e+08	3.425e-03	1.225e-01	5.421e-06	1.939e-04
0.1	2.481e+09	3.492e-01	8.082e+00	5.342e-04	1.236e-02
0.15	7.083e+06	6.493e-03	7.645e-02	1.069e-05	1.259e-04
0.2	5.741e+08	1.125e+00	9.432e+00	1.985e-03	1.665e-02
0.3	8.558e+08	3.793e+00	2.221e+01	7.195e-03	4.212e-02
0.4	5.377e+08	3.995e+00	1.897e+01	7.785e-03	3.696e-02
0.5	4.533e+07	4.967e-01	2.031e+00	9.750e-04	3.986e-03
0.6	1.170e+12	1.754e+04	6.402e+04	3.424e+01	1.250e+02
0.8	2.099e+09	5.151e+01	1.593e+02	9.798e-02	3.031e-01
1.0	2.951e+10	1.061e+03	2.931e+03	1.956e+00	5.403e+00
1.5	2.924e+10	2.093e+03	4.801e+03	3.521e+00	8.077e+00
2.0	1.046e+08	1.203e+01	2.482e+01	1.860e-02	3.839e-02
3.0	3.140e-09	6.873e-16	1.242e-15	9.325e-19	1.684e-18
TOTALS:	1.334e+12	2.077e+04	7.200e+04	3.985e+01	1.389e+02

Results - Dose Point # 4 - (0,1.83e+01,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.230e+04	2.062e-193	3.642e-30	1.769e-194	3.124e-31
0.02	1.141e+08	5.361e-87	1.461e-26	1.857e-88	5.062e-28
0.03	7.667e+10	1.924e-26	6.318e-23	1.907e-28	6.262e-25
0.04	2.041e+10	8.789e-12	2.841e-10	3.887e-14	1.256e-12
0.05	6.026e+08	1.364e-07	6.942e-06	3.634e-10	1.849e-08
0.06	6.855e+08	6.718e-05	3.553e-03	1.334e-07	7.058e-06
0.08	1.851e+08	3.048e-03	1.088e-01	4.823e-06	1.721e-04
0.1	2.481e+09	3.092e-01	7.150e+00	4.730e-04	1.094e-02
0.15	7.083e+06	5.731e-03	6.753e-02	9.437e-06	1.112e-04
0.2	5.741e+08	9.922e-01	8.332e+00	1.751e-03	1.471e-02
0.3	8.558e+08	3.346e+00	1.962e+01	6.346e-03	3.723e-02
0.4	5.377e+08	3.525e+00	1.677e+01	6.868e-03	3.267e-02
0.5	4.533e+07	4.383e-01	1.795e+00	8.604e-04	3.524e-03
0.6	1.170e+12	1.548e+04	5.662e+04	3.022e+01	1.105e+02
0.8	2.099e+09	4.548e+01	1.410e+02	8.651e-02	2.681e-01

ENGINEERING DESIGN FILE

Page : 4
 DOS File : VTANK Consolidation tank 1880 gal decayed 8yr top no shiel
 Run Date: August 24, 2004
 Run Time: 11:24:19 AM
 Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.4	5.377e+08	4.560e+00	2.161e+01	8.886e-03	4.211e-02
0.5	4.533e+07	5.669e-01	2.313e+00	1.113e-03	4.541e-03
0.6	1.170e+12	2.002e+04	7.292e+04	3.907e+01	1.423e+02
0.8	2.099e+09	5.876e+01	1.814e+02	1.118e-01	3.451e-01
1.0	2.951e+10	1.210e+03	3.336e+03	2.230e+00	6.150e+00
1.5	2.924e+10	2.385e+03	5.462e+03	4.012e+00	9.189e+00
2.0	1.046e+08	1.370e+01	2.823e+01	2.119e-02	4.365e-02
3.0	3.140e-09	7.822e-16	1.411e-15	1.061e-18	1.914e-18
TOTALS:	1.334e+12	2.369e+04	8.200e+04	4.546e+01	1.582e+02

Results - Dose Point # 3 - (0,1.73e+01,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.230e+04	2.182e-193	4.092e-30	1.872e-194	3.510e-31
0.02	1.141e+08	5.507e-87	1.642e-26	1.908e-88	5.687e-28
0.03	7.667e+10	1.976e-26	7.099e-23	1.958e-28	7.035e-25
0.04	2.041e+10	9.355e-12	3.028e-10	4.138e-14	1.339e-12
0.05	6.026e+08	1.491e-07	7.608e-06	3.973e-10	2.027e-08
0.06	6.855e+08	7.453e-05	3.954e-03	1.480e-07	7.853e-06
0.08	1.851e+08	3.425e-03	1.225e-01	5.421e-06	1.939e-04
0.1	2.481e+09	3.492e-01	8.082e+00	5.342e-04	1.236e-02
0.15	7.083e+06	6.493e-03	7.645e-02	1.069e-05	1.259e-04
0.2	5.741e+08	1.125e+00	9.432e+00	1.985e-03	1.665e-02
0.3	8.558e+08	3.793e+00	2.221e+01	7.195e-03	4.212e-02
0.4	5.377e+08	3.995e+00	1.897e+01	7.785e-03	3.696e-02
0.5	4.533e+07	4.967e-01	2.031e+00	9.750e-04	3.986e-03
0.6	1.170e+12	1.754e+04	6.402e+04	3.424e+01	1.250e+02
0.8	2.099e+09	5.151e+01	1.593e+02	9.798e-02	3.031e-01
1.0	2.951e+10	1.061e+03	2.931e+03	1.956e+00	5.403e+00
1.5	2.924e+10	2.093e+03	4.801e+03	3.521e+00	8.077e+00
2.0	1.046e+08	1.203e+01	2.482e+01	1.860e-02	3.839e-02
3.0	3.140e-09	6.873e-16	1.242e-15	9.325e-19	1.684e-18
TOTALS:	1.334e+12	2.077e+04	7.200e+04	3.985e+01	1.389e+02

Results - Dose Point # 4 - (0,1.83e+01,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.230e+04	2.062e-193	3.642e-30	1.769e-194	3.124e-31
0.02	1.141e+08	5.361e-87	1.461e-26	1.857e-88	5.062e-28
0.03	7.667e+10	1.924e-26	6.318e-23	1.907e-28	6.262e-25
0.04	2.041e+10	8.789e-12	2.841e-10	3.887e-14	1.256e-12
0.05	6.026e+08	1.364e-07	6.942e-06	3.634e-10	1.849e-08
0.06	6.855e+08	6.718e-05	3.553e-03	1.334e-07	7.058e-06
0.08	1.851e+08	3.048e-03	1.088e-01	4.823e-06	1.721e-04
0.1	2.481e+09	3.092e-01	7.150e+00	4.730e-04	1.094e-02
0.15	7.083e+06	5.731e-03	6.753e-02	9.437e-06	1.112e-04
0.2	5.741e+08	9.922e-01	8.332e+00	1.751e-03	1.471e-02
0.3	8.558e+08	3.346e+00	1.962e+01	6.346e-03	3.723e-02
0.4	5.377e+08	3.525e+00	1.677e+01	6.868e-03	3.267e-02
0.5	4.533e+07	4.383e-01	1.795e+00	8.604e-04	3.524e-03
0.6	1.170e+12	1.548e+04	5.662e+04	3.022e+01	1.105e+02
0.8	2.099e+09	4.548e+01	1.410e+02	8.651e-02	2.681e-01

ENGINEERING DESIGN FILE

Page : 5
 DOS File : VTANK Consolidation tank 1880 gal decayed 8yr top no shiel
 Run Date: August 24, 2004
 Run Time: 11:24:19 AM
 Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
1.0	2.951e+10	9.371e+02	2.594e+03	1.727e+00	4.781e+00
1.5	2.924e+10	1.850e+03	4.251e+03	3.112e+00	7.151e+00
2.0	1.046e+08	1.064e+01	2.199e+01	1.645e-02	3.400e-02
3.0	3.140e-09	6.083e-16	1.100e-15	8.253e-19	1.493e-18
TOTALS:	1.334e+12	1.833e+04	6.368e+04	3.518e+01	1.228e+02

Results - Dose Point # 5 - (0,1.93e+01,0) ft					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.230e+04	1.948e-193	3.246e-30	1.671e-194	2.784e-31
0.02	1.141e+08	5.218e-87	1.302e-26	1.807e-88	4.511e-28
0.03	7.667e+10	1.866e-26	5.631e-23	1.849e-28	5.581e-25
0.04	2.041e+10	8.231e-12	2.656e-10	3.640e-14	1.175e-12
0.05	6.026e+08	1.248e-07	6.337e-06	3.325e-10	1.688e-08
0.06	6.855e+08	6.069e-05	3.203e-03	1.205e-07	6.361e-06
0.08	1.851e+08	2.724e-03	9.706e-02	4.310e-06	1.536e-04
0.1	2.481e+09	2.753e-01	6.363e+00	4.211e-04	9.734e-03
0.15	7.083e+06	5.088e-03	6.004e-02	8.379e-06	9.887e-05
0.2	5.741e+08	8.806e-01	7.409e+00	1.554e-03	1.308e-02
0.3	8.558e+08	2.970e+00	1.746e+01	5.633e-03	3.311e-02
0.4	5.377e+08	3.130e+00	1.492e+01	6.098e-03	2.907e-02
0.5	4.533e+07	3.893e-01	1.598e+00	7.641e-04	3.136e-03
0.6	1.170e+12	1.375e+04	5.039e+04	2.684e+01	9.836e+01
0.8	2.099e+09	4.042e+01	1.255e+02	7.688e-02	2.387e-01
1.0	2.951e+10	8.330e+02	2.309e+03	1.535e+00	4.257e+00
1.5	2.924e+10	1.645e+03	3.786e+03	2.768e+00	6.370e+00
2.0	1.046e+08	9.468e+00	1.959e+01	1.464e-02	3.029e-02
3.0	3.140e-09	5.416e-16	9.806e-16	7.348e-19	1.330e-18
TOTALS:	1.334e+12	1.629e+04	5.668e+04	3.125e+01	1.093e+02

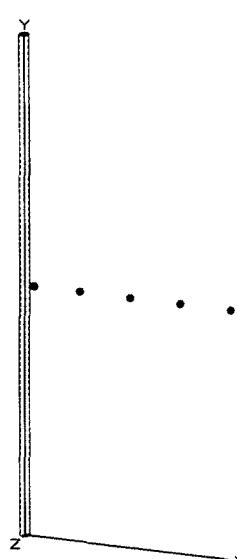
ENGINEERING DESIGN FILE

Page : 1
DOS File : VTANKPRB.MS5
Run Date: August 23, 2004
Run Time: 2:44:25 PM
Duration : 00:00:29

MicroShield v6.02 (6.02-00061) INEEL

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: TAN V tank Process
Description: V-tank waste processing facility piping Decayed 8 yrs
Geometry: 7 - Cylinder Volume - Side Shields



	Source Dimensions		
Height	304.8 cm	10 ft 0.0 in	
Radius	2.54 cm	1.0 in	

	Dose Points		
	X	Y	Z
# 1	5.4712 cm 2.2 in	152 cm 4 ft 11.8 in	0 cm 0.0 in
# 2	33.4112 cm 1 ft 1.2 in	152 cm 4 ft 11.8 in	0 cm 0.0 in
# 3	63.8912 cm 2 ft 1.2 in	152 cm 4 ft 11.8 in	0 cm 0.0 in
# 4	94.3712 cm 3 ft 1.2 in	152 cm 4 ft 11.8 in	0 cm 0.0 in
# 5	124.8512 cm 4 ft 1.2 in	152 cm 4 ft 11.8 in	0 cm 0.0 in

	Shields			
Shield Name	Dimension	Material	Density	
Source	6177.778 cm ³	V123 SLUDGE	1.02	
Shield 1	.391 cm	304L	8	
Transition		Air	0.00122	
Air Gap		Air	0.00122	

Source Input
Grouping Method : Standard Indices

Number of Groups : 25
Lower Energy Cutoff : 0.015

Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	1.7828e-008	6.5963e+002	2.8858e-006	1.0677e-001
Ac-227	1.5079e-011	5.5791e-001	2.4408e-009	9.0310e-005
Ac-228	4.4982e-022	1.6643e-011	7.2813e-020	2.6941e-015
Ag-108	3.7925e-007	1.4032e+004	6.1390e-005	2.2714e+000
Ag-108m	4.0780e-006	1.5089e+005	6.6011e-004	2.4424e+001
Ag-110	2.9885e-011	1.1058e+000	4.8375e-009	1.7899e-004
Ag-110m	2.2470e-009	8.3139e+001	3.6372e-007	1.3458e-002
Am-241	4.4130e-005	1.6328e+006	7.1434e-003	2.6430e+002
Am-243	1.8838e-011	6.9701e-001	3.0493e-009	1.1282e-004
At-217	1.7828e-008	6.5963e+002	2.8858e-006	1.0677e-001
Ba-137m	3.0464e-002	1.1271e+009	4.9311e+000	1.8245e+005
Bi-210	2.0142e-006	7.4524e+004	3.2604e-004	1.2063e+001
Bi-211	1.4655e-011	5.4225e-001	2.3723e-009	8.7774e-005
Bi-212	2.0547e-022	7.6023e-012	3.3259e-020	1.2306e-015
Bi-213	1.7827e-008	6.5962e+002	2.8857e-006	1.0677e-001
Bi-214	9.1564e-006	3.3879e+005	1.4822e-003	5.4840e+001
Ce-144	4.1401e-008	1.5318e+003	6.7017e-006	2.4796e-001
Cm-242	7.2553e-013	2.6845e-002	1.1744e-010	4.3453e-006
Cm-243	9.4667e-006	3.5027e+005	1.5324e-003	5.6698e+001
Cm-244	8.4668e-006	3.1327e+005	1.3705e-003	5.0709e+001
Co-58	2.8563e-018	1.0568e-007	4.6235e-016	1.7107e-011
Co-60	6.3560e-004	2.3517e+007	1.0289e-001	3.8068e+003
Cs-134	3.5665e-007	1.3196e+004	5.7731e-005	2.1361e+000

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANKPRB.MS5
Run Date: August 23, 2004
Run Time: 2:44:25 PM
Duration : 00:00:29

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Cs-137	3.2202e-002	1.1915e+009	5.2126e+000	1.9287e+005
Eu-152	6.1993e-005	2.2937e+006	1.0035e-002	3.7129e+002
Eu-154	8.5736e-005	3.1722e+006	1.3878e-002	5.1349e+002
Eu-155	5.8522e-006	2.1653e+005	9.4730e-004	3.5050e+001
Fr-221	1.7828e-008	6.5963e+002	2.8858e-006	1.0677e-001
Fr-223	2.0808e-013	7.6991e-003	3.3683e-011	1.2463e-006
Gd-152	1.0726e-018	3.9687e-008	1.7363e-016	6.4242e-012
I-129	2.9200e-007	1.0804e+004	4.7266e-005	1.7488e+000
Mn-54	4.2150e-009	1.5596e+002	6.8229e-007	2.5245e-002
Nb-95	6.2006e-019	2.2942e-008	1.0037e-016	3.7137e-012
Nb-95m	2.3779e-021	8.7983e-011	3.8492e-019	1.4242e-014
Ni-63	4.5224e-003	1.6733e+008	7.3204e-001	2.7086e+004
Np-237	1.4511e-007	5.3692e+003	2.3490e-005	8.6912e-001
Np-239	1.8818e-011	6.9627e-001	3.0461e-009	1.1271e-004
Pa-231	1.2873e-010	4.7631e+000	2.0838e-008	7.7101e-004
Pa-233	1.4511e-007	5.3692e+003	2.3490e-005	8.6911e-001
Pa-234	6.5120e-010	2.4094e+001	1.0541e-007	3.9002e-003
Pa-234m	4.0700e-007	1.5059e+004	6.5881e-005	2.4376e+000
Pb-209	1.7826e-008	6.5957e+002	2.8855e-006	1.0677e-001
Pb-210	2.0186e-006	7.4687e+004	3.2675e-004	1.2090e+001
Pb-211	1.4655e-011	5.4225e-001	2.3723e-009	8.7774e-005
Pb-212	2.0548e-022	7.6029e-012	3.3262e-020	1.2307e-015
Pb-214	9.1564e-006	3.3879e+005	1.4822e-003	5.4840e+001
Po-210	1.8905e-006	6.9949e+004	3.0602e-004	1.1323e+001
Po-211	4.0009e-014	1.4803e-003	6.4763e-012	2.3962e-007
Po-212	1.3164e-022	4.8708e-012	2.1309e-020	7.8844e-016
Po-213	1.7442e-008	6.4537e+002	2.8234e-006	1.0447e-001
Po-214	9.1545e-006	3.3872e+005	1.4818e-003	5.4828e+001
Po-215	1.4656e-011	5.4226e-001	2.3723e-009	8.7777e-005
Po-216	2.0563e-022	7.6085e-012	3.3286e-020	1.2316e-015
Po-218	9.1583e-006	3.3886e+005	1.4825e-003	5.4851e+001
Pr-144	4.1403e-008	1.5319e+003	6.7019e-006	2.4797e-001
Pr-144m	5.9205e-010	2.1906e+001	9.5835e-008	3.5459e-003
Pu-238	6.9845e-005	2.5843e+006	1.1306e-002	4.1831e+002
Pu-239	3.7494e-005	1.3873e+006	6.0691e-003	2.2456e+002
Pu-240	3.7477e-005	1.3866e+006	6.0664e-003	2.2446e+002
Ra-223	1.4656e-011	5.4226e-001	2.3723e-009	8.7777e-005
Ra-224	2.0563e-022	7.6085e-012	3.3286e-020	1.2316e-015
Ra-225	1.7917e-008	6.6292e+002	2.9002e-006	1.0731e-001
Ra-226	9.1582e-006	3.3885e+005	1.4824e-003	5.4850e+001
Ra-228	4.4998e-022	1.6649e-011	7.2838e-020	2.6950e-015
Rh-103m	2.9242e-027	1.0819e-016	4.7334e-025	1.7513e-020
Rh-106	2.2705e-007	8.4010e+003	3.6753e-005	1.3599e+000
Rn-219	1.4656e-011	5.4226e-001	2.3723e-009	8.7777e-005
Rn-220	2.0563e-022	7.6085e-012	3.3286e-020	1.2316e-015
Rn-222	9.1583e-006	3.3886e+005	1.4825e-003	5.4851e+001
Ru-103	2.9290e-027	1.0837e-016	4.7412e-025	1.7542e-020
Ru-106	2.2705e-007	8.4010e+003	3.6753e-005	1.3599e+000
Sb-125	3.0123e-006	1.1146e+005	4.8761e-004	1.8042e+001
Sr-90	5.9475e-002	2.2006e+009	9.6272e+000	3.5621e+005
Te-125m	7.3817e-007	2.7312e+004	1.1949e-004	4.4210e+000
Th-227	1.4609e-011	5.4053e-001	2.3648e-009	8.7496e-005
Th-228	2.0689e-022	7.6549e-012	3.3489e-020	1.2391e-015
Th-229	1.8049e-008	6.6780e+002	2.9216e-006	1.0810e-001
Th-230	1.7211e-009	6.3682e+001	2.7860e-007	1.0308e-002
Th-231	7.6100e-007	2.8157e+004	1.2318e-004	4.5578e+000
Th-232	1.7522e-021	6.4830e-011	2.8362e-019	1.0494e-014
Th-234	4.0700e-007	1.5059e+004	6.5881e-005	2.4376e+000
Tl-207	1.4615e-011	5.4077e-001	2.3658e-009	8.7534e-005
Tl-208	7.3825e-023	2.7315e-012	1.1950e-020	4.4215e-016

ENGINEERING DESIGN FILE

Page : 3
DOS File : VTANKPRB.MS5
Run Date: August 23, 2004
Run Time: 2:44:25 PM
Duration : 00:00:29

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Tl-209	3.8507e-010	1.4248e+001	6.2332e-008	2.3063e-003
U-233	2.3899e-005	8.8427e+005	3.8686e-003	1.4314e+002
U-234	2.3901e-005	8.8434e+005	3.8689e-003	1.4315e+002
U-235	7.6100e-007	2.8157e+004	1.2318e-004	4.5578e+000
U-236	8.8781e-012	3.2849e-001	1.4371e-009	5.3173e-005
U-238	4.0700e-007	1.5059e+004	6.5881e-005	2.4376e+000
Y-90	5.9490e-002	2.2011e+009	9.6297e+000	3.5630e+005
Zn-65	1.7294e-009	6.3988e+001	2.7994e-007	1.0358e-002
Zr-95	2.8049e-019	1.0378e-008	4.5403e-017	1.6799e-012

Buildup
The material reference is : Shield 1

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (5.4712,152,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
0.015	5.412e+01	5.479e-93	1.096e-30	4.699e-94	9.405e-32
0.02	9.917e+04	1.285e-41	3.134e-27	4.450e-43	1.086e-28
0.03	6.652e+07	1.186e-11	1.295e-11	1.176e-13	1.284e-13
0.04	1.772e+07	5.700e-05	6.625e-05	2.521e-07	2.930e-07
0.05	5.247e+05	9.813e-04	1.221e-03	2.614e-06	3.253e-06
0.06	5.950e+05	2.220e-02	2.942e-02	4.409e-05	5.843e-05
0.08	1.606e+05	8.403e-02	1.231e-01	1.330e-04	1.948e-04
0.1	2.160e+06	3.517e+00	5.594e+00	5.381e-03	8.559e-03
0.15	6.156e+03	3.257e-02	5.781e-02	5.363e-05	9.520e-05
0.2	4.996e+05	4.517e+00	8.340e+00	7.972e-03	1.472e-02
0.3	7.451e+05	1.238e+01	2.254e+01	2.348e-02	4.275e-02
0.4	4.674e+05	1.149e+01	2.003e+01	2.239e-02	3.903e-02
0.5	3.940e+04	1.300e+00	2.165e+00	2.552e-03	4.249e-03
0.6	1.015e+09	4.242e+04	6.781e+04	8.280e+01	1.323e+02
0.8	1.827e+06	1.104e+02	1.655e+02	2.099e-01	3.148e-01
1.0	2.558e+07	2.050e+03	2.937e+03	3.779e+00	5.413e+00
1.5	2.535e+07	3.365e+03	4.467e+03	5.662e+00	7.516e+00
2.0	9.068e+04	1.703e+01	2.172e+01	2.634e-02	3.358e-02
3.0	2.726e-12	8.219e-16	9.986e-16	1.115e-18	1.355e-18
TOTALS:	1.157e+09	4.799e+04	7.546e+04	9.254e+01	1.457e+02

Results - Dose Point # 2 - (33.4112,152,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
0.015	5.412e+01	9.147e-85	1.523e-31	7.845e-86	1.306e-32
0.02	9.917e+04	5.939e-39	4.352e-28	2.057e-40	1.508e-29
0.03	6.652e+07	8.159e-12	8.862e-12	8.086e-14	8.783e-14
0.04	1.772e+07	1.088e-05	1.261e-05	4.812e-08	5.578e-08
0.05	5.247e+05	1.436e-04	1.784e-04	3.825e-07	4.754e-07
0.06	5.950e+05	3.141e-03	4.161e-03	6.240e-06	8.265e-06
0.08	1.606e+05	1.231e-02	1.812e-02	1.947e-05	2.868e-05
0.1	2.160e+06	5.276e-01	8.450e-01	8.072e-04	1.293e-03
0.15	6.156e+03	4.974e-03	8.915e-03	8.191e-06	1.468e-05
0.2	4.996e+05	6.924e-01	1.289e+00	1.222e-03	2.274e-03

ENGINEERING DESIGN FILE

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<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.3	7.451e+05	1.901e+00	3.467e+00	3.606e-03	6.577e-03
0.4	4.674e+05	1.765e+00	3.071e+00	3.439e-03	5.984e-03
0.5	3.940e+04	1.996e-01	3.308e-01	3.918e-04	6.493e-04
0.6	1.015e+09	6.510e+03	1.033e+04	1.271e+01	2.017e+01
0.8	1.827e+06	1.691e+01	2.512e+01	3.217e-02	4.778e-02
1.0	2.558e+07	3.137e+02	4.441e+02	5.783e-01	8.187e-01
1.5	2.535e+07	5.129e+02	6.707e+02	8.630e-01	1.128e+00
2.0	9.068e+04	2.587e+00	3.244e+00	4.001e-03	5.016e-03
3.0	2.726e-12	1.242e-16	1.484e-16	1.685e-19	2.013e-19
TOTALS:	1.157e+09	7.361e+03	1.149e+04	1.419e+01	2.219e+01

Results - Dose Point # 3 - (63,8912,152,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.412e+01	3.761e-85	6.894e-32	3.226e-86	5.914e-33
0.02	9.917e+04	3.033e-39	1.970e-28	1.051e-40	6.826e-30
0.03	6.652e+07	4.232e-12	4.597e-12	4.194e-14	4.555e-14
0.04	1.772e+07	5.632e-06	6.528e-06	2.491e-08	2.887e-08
0.05	5.247e+05	7.449e-05	9.257e-05	1.984e-07	2.466e-07
0.06	5.950e+05	1.630e-03	2.160e-03	3.238e-06	4.290e-06
0.08	1.606e+05	6.374e-03	9.389e-03	1.009e-05	1.486e-05
0.1	2.160e+06	2.717e-01	4.345e-01	4.157e-04	6.647e-04
0.15	6.156e+03	2.520e-03	4.476e-03	4.149e-06	7.371e-06
0.2	4.996e+05	3.473e-01	6.358e-01	6.130e-04	1.122e-03
0.3	7.451e+05	9.439e-01	1.678e+00	1.790e-03	3.184e-03
0.4	4.674e+05	8.708e-01	1.472e+00	1.697e-03	2.867e-03
0.5	3.940e+04	9.803e-02	1.575e-01	1.924e-04	3.092e-04
0.6	1.015e+09	3.185e+03	4.901e+03	6.217e+00	9.566e+00
0.8	1.827e+06	8.225e+00	1.185e+01	1.564e-02	2.254e-02
1.0	2.558e+07	1.518e+02	2.088e+02	2.799e-01	3.849e-01
1.5	2.535e+07	2.460e+02	3.136e+02	4.140e-01	5.277e-01
2.0	9.068e+04	1.234e+00	1.512e+00	1.908e-03	2.338e-03
3.0	2.726e-12	5.885e-17	6.892e-17	7.985e-20	9.351e-20
TOTALS:	1.157e+09	3.595e+03	5.441e+03	6.933e+00	1.051e+01

Results - Dose Point # 4 - (94,3712,152,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.412e+01	2.486e-85	4.041e-32	2.132e-86	3.466e-33
0.02	9.917e+04	1.995e-39	1.155e-28	6.911e-41	4.001e-30
0.03	6.652e+07	2.830e-12	3.074e-12	2.805e-14	3.047e-14
0.04	1.772e+07	3.779e-06	4.380e-06	1.671e-08	1.937e-08
0.05	5.247e+05	5.003e-05	6.217e-05	1.333e-07	1.656e-07
0.06	5.950e+05	1.093e-03	1.448e-03	2.171e-06	2.876e-06
0.08	1.606e+05	4.216e-03	6.201e-03	6.672e-06	9.813e-06
0.1	2.160e+06	1.766e-01	2.812e-01	2.702e-04	4.302e-04
0.15	6.156e+03	1.596e-03	2.801e-03	2.628e-06	4.613e-06
0.2	4.996e+05	2.176e-01	3.912e-01	3.840e-04	6.904e-04
0.3	7.451e+05	5.854e-01	1.018e+00	1.111e-03	1.930e-03
0.4	4.674e+05	5.372e-01	8.863e-01	1.047e-03	1.727e-03
0.5	3.940e+04	6.025e-02	9.452e-02	1.183e-04	1.855e-04
0.6	1.015e+09	1.952e+03	2.934e+03	3.810e+00	5.727e+00

ENGINEERING DESIGN FILE

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 DOS File : VTANKPRB.MS5
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 Run Time: 2:44:25 PM
 Duration : 00:00:29

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.8	1.827e+06	5.018e+00	7.076e+00	9.545e-03	1.346e-02
1.0	2.558e+07	9.231e+01	1.245e+02	1.702e-01	2.295e-01
1.5	2.535e+07	1.487e+02	1.865e+02	2.503e-01	3.138e-01
2.0	9.068e+04	7.435e-01	8.978e-01	1.150e-03	1.388e-03
3.0	2.726e-12	3.531e-17	4.086e-17	4.791e-20	5.544e-20
TOTALS:	1.157e+09	2.200e+03	3.256e+03	4.244e+00	6.291e+00

Results - Dose Point # 5 - (124.8512,152.0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.412e+01	1.760e-85	2.658e-32	1.510e-86	2.280e-33
0.02	9.917e+04	1.468e-39	7.596e-29	5.083e-41	2.631e-30
0.03	6.652e+07	2.114e-12	2.296e-12	2.095e-14	2.275e-14
0.04	1.772e+07	2.831e-06	3.281e-06	1.252e-08	1.451e-08
0.05	5.247e+05	3.742e-05	4.651e-05	9.969e-08	1.239e-07
0.06	5.950e+05	8.108e-04	1.074e-03	1.610e-06	2.133e-06
0.08	1.606e+05	3.046e-03	4.469e-03	4.821e-06	7.072e-06
0.1	2.160e+06	1.250e-01	1.981e-01	1.913e-04	3.030e-04
0.15	6.156e+03	1.103e-03	1.917e-03	1.817e-06	3.157e-06
0.2	4.996e+05	1.491e-01	2.645e-01	2.632e-04	4.668e-04
0.3	7.451e+05	3.985e-01	6.816e-01	7.558e-04	1.293e-03
0.4	4.674e+05	3.643e-01	5.914e-01	7.098e-04	1.152e-03
0.5	3.940e+04	4.076e-02	6.294e-02	8.001e-05	1.235e-04
0.6	1.015e+09	1.318e+03	1.952e+03	2.572e+00	3.809e+00
0.8	1.827e+06	3.378e+00	4.700e+00	6.426e-03	8.939e-03
1.0	2.558e+07	6.202e+01	8.263e+01	1.143e-01	1.523e-01
1.5	2.535e+07	9.958e+01	1.236e+02	1.675e-01	2.080e-01
2.0	9.068e+04	4.967e-01	5.945e-01	7.681e-04	9.194e-04
3.0	2.726e-12	2.354e-17	2.704e-17	3.193e-20	3.669e-20
TOTALS:	1.157e+09	1.484e+03	2.165e+03	2.863e+00	4.183e+00

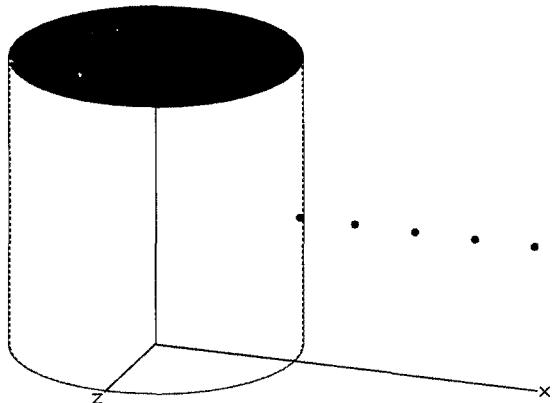
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
DOS File : VTANK RX vessel 600 gal decayed 8yr.ms6
Run Date: September 7, 2004
Run Time: 10:26:52 AM
Duration : 00:00:31

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: Reaction Vessel
Description: 600 gal of sludge decayed 8 yr vessel wall only
Geometry: 7 - Cylinder Volume - Side Shields



	Source Dimensions		
	Height	147.0 cm	4 ft 9.9 in
	Radius	70.104 cm	2 ft 3.6 in

	Dose Points		
#	X	Y	Z
# 1	73.279 cm 2 ft 4.9 in	73.5 cm	0 cm 0.0 in
# 2	101.219 cm 3 ft 3.9 in	73.5 cm	0 cm 0.0 in
# 3	131.699 cm 4 ft 3.9 in	73.5 cm	0 cm 0.0 in
# 4	162.179 cm 5 ft 3.9 in	73.5 cm	0 cm 0.0 in
# 5	192.659 cm 6 ft 3.9 in	73.5 cm	0 cm 0.0 in

Shield Name	Shields			
Source	2.27e+06 cm ³	V123 SLUDGE	1.02	
Shield 1	.635 cm	Iron	7.86	
Transition		Air	0.00122	
Air Gap		Air	0.00122	

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	6.5493e-006	2.4232e+005	2.8856e-006	1.0677e-001
Ac-227	5.5480e-009	2.0528e+002	2.4445e-009	9.0446e-005
Ac-228	1.6553e-019	6.1248e-009	7.2935e-020	2.6986e-015
Ag-108	1.3888e-004	5.1386e+006	6.1192e-005	2.2641e+000
Ag-108m	1.4934e-003	5.5254e+007	6.5797e-004	2.4345e+001
Ag-110	1.0991e-008	4.0668e+002	4.8428e-009	1.7918e-004
Ag-110m	8.2642e-007	3.0577e+004	3.6412e-007	1.3473e-002
Am-241	1.6191e-002	5.9906e+008	7.1338e-003	2.6395e+002
Am-243	6.8963e-009	2.5516e+002	3.0385e-009	1.1243e-004
At-217	6.5493e-006	2.4232e+005	2.8856e-006	1.0677e-001
Ba-137m	1.1178e+001	4.1358e+011	4.9250e+000	1.8222e+005
Bi-210	7.4080e-004	2.7409e+007	3.2640e-004	1.2077e+001
Bi-211	5.3923e-009	1.9951e+002	2.3758e-009	8.7906e-005
Bi-212	7.5612e-020	2.7976e-009	3.3315e-020	1.2326e-015
Bi-213	6.5492e-006	2.4232e+005	2.8856e-006	1.0677e-001
Bi-214	3.3677e-003	1.2460e+008	1.4838e-003	5.4901e+001
Ce-144	1.5223e-005	5.6327e+005	6.7075e-006	2.4818e-001
Cm-242	2.6698e-010	9.8782e+000	1.1763e-010	4.3524e-006
Cm-243	3.4656e-003	1.2823e+008	1.5270e-003	5.6498e+001
Cm-244	3.0996e-003	1.1468e+008	1.3657e-003	5.0530e+001
Co-58	1.0513e-015	3.8899e-005	4.6322e-016	1.7139e-011
Co-60	2.3434e-001	8.6704e+009	1.0325e-001	3.8202e+003
Cs-134	1.3111e-004	4.8511e+006	5.7768e-005	2.1374e+000

Page : 2
DOS File : VTANK RX vessel 600 gal decayed 8yr.ms6
Run Date: September 7, 2004
Run Time: 10:26:52 AM
Duration : 00:00:31

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Cs-137	1.1816e+001	4.3719e+011	5.2061e+000	1.9263e+005
Eu-152	2.2815e-002	8.4415e+008	1.0052e-002	3.7193e+002
Eu-154	3.1419e-002	1.1625e+009	1.3843e-002	5.1220e+002
Eu-155	2.1480e-003	7.9476e+007	9.4641e-004	3.5017e+001
Fr-221	6.5493e-006	2.4232e+005	2.8856e-006	1.0677e-001
Fr-223	7.6562e-011	2.8328e+000	3.3733e-011	1.2481e-006
Gd-152	3.9475e-016	1.4606e-005	1.7393e-016	6.4354e-012
I-129	1.0700e-004	3.9590e+006	4.7144e-005	1.7443e+000
Mn-54	1.5537e-006	5.7487e+004	6.8457e-007	2.5329e-002
Nb-95	2.2789e-016	8.4320e-006	1.0041e-016	3.7152e-012
Nb-95m	8.7397e-019	3.2337e-008	3.8507e-019	1.4248e-014
Ni-63	1.6652e+000	6.1611e+010	7.3367e-001	2.7146e+004
Np-237	5.3442e-005	1.9774e+006	2.3547e-005	8.7123e-001
Np-239	6.8891e-009	2.5490e+002	3.0353e-009	1.1231e-004
Pa-231	4.7366e-008	1.7525e+003	2.0870e-008	7.7217e-004
Pa-233	5.3442e-005	1.9773e+006	2.3546e-005	8.7122e-001
Pa-234	2.4000e-007	8.8800e+003	1.0574e-007	3.9126e-003
Pa-234m	1.5000e-004	5.5500e+006	6.6090e-005	2.4453e+000
Pb-209	6.5487e-006	2.4230e+005	2.8854e-006	1.0676e-001
Pb-210	7.4241e-004	2.7469e+007	3.2711e-004	1.2103e+001
Pb-211	5.3923e-009	1.9951e+002	2.3758e-009	8.7906e-005
Pb-212	7.5618e-020	2.7979e-009	3.3317e-020	1.2327e-015
Pb-214	3.3677e-003	1.2460e+008	1.4838e-003	5.4901e+001
Po-210	6.9531e-004	2.5726e+007	3.0636e-004	1.1335e+001
Po-211	1.4721e-011	5.4467e-001	6.4860e-012	2.3998e-007
Po-212	4.8445e-020	1.7924e-009	2.1345e-020	7.8976e-016
Po-213	6.4077e-006	2.3709e+005	2.8233e-006	1.0446e-001
Po-214	3.3669e-003	1.2458e+008	1.4835e-003	5.4889e+001
Po-215	5.3924e-009	1.9952e+002	2.3759e-009	8.7909e-005
Po-216	7.5673e-020	2.7999e-009	3.3342e-020	1.2336e-015
Po-218	3.3683e-003	1.2463e+008	1.4841e-003	5.4912e+001
Pr-144	1.5224e-005	5.6329e+005	6.7077e-006	2.4819e-001
Pr-144m	2.1770e-007	8.0549e+003	9.5919e-008	3.5490e-003
Pu-238	2.5722e-002	9.5173e+008	1.1333e-002	4.1933e+002
Pu-239	1.3798e-002	5.1052e+008	6.0793e-003	2.2493e+002
Pu-240	1.3791e-002	5.1028e+008	6.0765e-003	2.2483e+002
Ra-223	5.3924e-009	1.9952e+002	2.3759e-009	8.7909e-005
Ra-224	7.5674e-020	2.7999e-009	3.3342e-020	1.2337e-015
Ra-225	6.5820e-006	2.4353e+005	2.9001e-006	1.0730e-001
Ra-226	3.3683e-003	1.2463e+008	1.4841e-003	5.4911e+001
Ra-228	1.6559e-019	6.1269e-009	7.2960e-020	2.6995e-015
Rh-103m	1.0750e-024	3.9775e-014	4.7365e-025	1.7525e-020
Rh-106	8.3308e-005	3.0824e+006	3.6706e-005	1.3581e+000
Rn-219	5.3924e-009	1.9952e+002	2.3759e-009	8.7909e-005
Rn-220	7.5673e-020	2.7999e-009	3.3342e-020	1.2336e-015
Rn-222	3.3683e-003	1.2463e+008	1.4841e-003	5.4912e+001
Ru-103	1.0768e-024	3.9840e-014	4.7443e-025	1.7554e-020
Ru-106	8.3308e-005	3.0824e+006	3.6706e-005	1.3581e+000
Sb-125	1.1063e-003	4.0934e+007	4.8745e-004	1.8036e+001
Sr-90	2.1829e+001	8.0769e+011	9.6181e+000	3.5587e+005
Te-125m	2.7110e-004	1.0031e+007	1.1945e-004	4.4196e+000
Th-227	5.3752e-009	1.9888e+002	2.3683e-009	8.7628e-005
Th-228	7.6135e-020	2.8170e-009	3.3545e-020	1.2412e-015
Th-229	6.6304e-006	2.4533e+005	2.9214e-006	1.0809e-001
Th-230	6.3229e-007	2.3395e+004	2.7859e-007	1.0308e-002
Th-231	2.8000e-004	1.0360e+007	1.2337e-004	4.5646e+000
Th-232	6.4480e-019	2.3857e-008	2.8410e-019	1.0512e-014
Th-234	1.5000e-004	5.5500e+006	6.6090e-005	2.4453e+000
Tl-207	5.3775e-009	1.9897e+002	2.3693e-009	8.7666e-005
Tl-208	2.7168e-020	1.0052e-009	1.1970e-020	4.4289e-016

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<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
TI-209	1.4146e-007	5.2341e+003	6.2329e-008	2.3062e-003
U-233	8.7797e-003	3.2485e+008	3.8684e-003	1.4313e+002
U-234	8.7804e-003	3.2488e+008	3.8687e-003	1.4314e+002
U-235	2.8000e-004	1.0360e+007	1.2337e-004	4.5646e+000
U-236	3.2671e-009	1.2088e+002	1.4395e-009	5.3262e-005
U-238	1.5000e-004	5.5500e+006	6.6090e-005	2.4453e+000
Y-90	2.1835e+001	8.0789e+011	9.6206e+000	3.5596e+005
Zn-65	6.3689e-007	2.3565e+004	2.8061e-007	1.0383e-002
Zr-95	1.0309e-016	3.8143e-006	4.5421e-017	1.6806e-012

Buildup
The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (73.279,73.5,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.991e+04	3.736e-141	6.568e-29	3.204e-142	5.633e-30
0.02	3.632e+07	1.035e-62	2.625e-25	3.587e-64	9.093e-27
0.03	2.441e+10	6.020e-18	6.137e-17	5.966e-20	6.082e-19
0.04	6.502e+09	1.366e-07	3.141e-06	6.042e-10	1.389e-08
0.05	1.928e+08	4.957e-05	1.632e-03	1.320e-07	4.347e-06
0.06	2.183e+08	4.682e-03	1.602e-01	9.300e-06	3.182e-04
0.08	5.901e+07	6.750e-02	1.778e+00	1.068e-04	2.813e-03
0.1	7.924e+08	5.081e+00	9.809e+01	7.773e-03	1.501e-01
0.15	2.263e+06	8.257e-02	9.374e-01	1.360e-04	1.544e-03
0.2	1.834e+08	1.414e+01	1.193e+02	2.496e-02	2.105e-01
0.3	2.741e+08	4.793e+01	2.898e+02	9.092e-02	5.498e-01
0.4	1.717e+08	5.057e+01	2.502e+02	9.853e-02	4.874e-01
0.5	1.448e+07	6.321e+00	2.703e+01	1.241e-02	5.305e-02
0.6	3.724e+11	2.236e+05	8.550e+05	4.365e+02	1.669e+03
0.8	6.701e+08	6.645e+02	2.155e+03	1.264e+00	4.099e+00
1.0	9.429e+09	1.381e+04	3.996e+04	2.546e+01	7.366e+01
1.5	9.344e+09	2.770e+04	6.632e+04	4.660e+01	1.116e+02
2.0	3.335e+07	1.608e+02	3.453e+02	2.486e-01	5.339e-01
3.0	1.003e-09	9.341e-15	1.749e-14	1.267e-17	2.373e-17
TOTALS:	4.247e+11	2.661e+05	9.645e+05	5.103e+02	1.860e+03

Results - Dose Point # 2 - (101.219,73.5,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.991e+04	7.414e-131	3.165e-29	6.359e-132	2.715e-30
0.02	3.632e+07	4.894e-59	1.265e-25	1.695e-60	4.382e-27
0.03	2.441e+10	1.198e-17	1.189e-16	1.188e-19	1.178e-18
0.04	6.502e+09	8.599e-08	1.931e-06	3.803e-10	8.541e-09
0.05	1.928e+08	2.881e-05	9.638e-04	7.675e-08	2.567e-06
0.06	2.183e+08	2.917e-03	1.034e-01	5.793e-06	2.054e-04
0.08	5.901e+07	4.488e-02	1.198e+00	7.102e-05	1.895e-03
0.1	7.924e+08	3.381e+00	6.420e+01	5.173e-03	9.823e-02
0.15	2.263e+06	5.328e-02	5.723e-01	8.774e-05	9.424e-04
0.2	1.834e+08	8.938e+00	7.042e+01	1.577e-02	1.243e-01

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<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.3	2.741e+08	2.961e+01	1.664e+02	5.618e-02	3.156e-01
0.4	1.717e+08	3.082e+01	1.416e+02	6.005e-02	2.760e-01
0.5	1.448e+07	3.812e+00	1.516e+01	7.482e-03	2.976e-02
0.6	3.724e+11	1.337e+05	4.760e+05	2.609e+02	9.292e+02
0.8	6.701e+08	3.913e+02	1.186e+03	7.444e-01	2.255e+00
1.0	9.429e+09	8.034e+03	2.179e+04	1.481e+01	4.017e+01
1.5	9.344e+09	1.574e+04	3.557e+04	2.648e+01	5.984e+01
2.0	3.335e+07	8.988e+01	1.832e+02	1.390e-01	2.832e-01
3.0	1.003e-09	5.115e-15	9.162e-15	6.940e-18	1.243e-17
TOTALS:	4.247e+11	1.580e+05	5.352e+05	3.032e+02	1.033e+03

Results - Dose Point # 3 - (131.699,73.5,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.991e+04	5.032e-131	1.842e-29	4.316e-132	1.580e-30
0.02	3.632e+07	3.144e-59	7.361e-26	1.089e-60	2.550e-27
0.03	2.441e+10	9.467e-18	9.389e-17	9.382e-20	9.305e-19
0.04	6.502e+09	6.477e-08	1.454e-06	2.865e-10	6.431e-09
0.05	1.928e+08	2.179e-05	7.292e-04	5.803e-08	1.942e-06
0.06	2.183e+08	2.189e-03	7.722e-02	4.348e-06	1.534e-04
0.08	5.901e+07	3.254e-02	8.444e-01	5.149e-05	1.336e-03
0.1	7.924e+08	2.358e+00	4.262e+01	3.608e-03	6.521e-02
0.15	2.263e+06	3.517e-02	3.562e-01	5.792e-05	5.865e-04
0.2	1.834e+08	5.772e+00	4.295e+01	1.019e-02	7.581e-02
0.3	2.741e+08	1.877e+01	1.002e+02	3.560e-02	1.900e-01
0.4	1.717e+08	1.933e+01	8.482e+01	3.767e-02	1.653e-01
0.5	1.448e+07	2.375e+00	9.051e+00	4.661e-03	1.777e-02
0.6	3.724e+11	8.281e+04	2.836e+05	1.616e+02	5.535e+02
0.8	6.701e+08	2.404e+02	7.040e+02	4.573e-01	1.339e+00
1.0	9.429e+09	4.905e+03	1.291e+04	9.042e+00	2.380e+01
1.5	9.344e+09	9.506e+03	2.099e+04	1.599e+01	3.532e+01
2.0	3.335e+07	5.395e+01	1.079e+02	8.343e-02	1.668e-01
3.0	1.003e-09	3.050e-15	5.384e-15	4.137e-18	7.304e-18
TOTALS:	4.247e+11	9.756e+04	3.186e+05	1.873e+02	6.147e+02

Results - Dose Point # 4 - (162.179,73.5,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.991e+04	3.513e-131	1.205e-29	3.013e-132	1.034e-30
0.02	3.632e+07	2.485e-59	4.818e-26	8.609e-61	1.669e-27
0.03	2.441e+10	7.564e-18	7.501e-17	7.497e-20	7.434e-19
0.04	6.502e+09	5.201e-08	1.168e-06	2.300e-10	5.166e-09
0.05	1.928e+08	1.725e-05	5.750e-04	4.596e-08	1.532e-06
0.06	2.183e+08	1.686e-03	5.867e-02	3.349e-06	1.165e-04
0.08	5.901e+07	2.363e-02	5.953e-01	3.739e-05	9.420e-04
0.1	7.924e+08	1.653e+00	2.889e+01	2.528e-03	4.420e-02
0.15	2.263e+06	2.378e-02	2.338e-01	3.916e-05	3.850e-04
0.2	1.834e+08	3.855e+00	2.801e+01	6.805e-03	4.943e-02
0.3	2.741e+08	1.242e+01	6.513e+01	2.357e-02	1.235e-01
0.4	1.717e+08	1.275e+01	5.512e+01	2.484e-02	1.074e-01
0.5	1.448e+07	1.562e+00	5.879e+00	3.066e-03	1.154e-02
0.6	3.724e+11	5.436e+04	1.842e+05	1.061e+02	3.595e+02

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		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.8	6.701e+08	1.575e+02	4.572e+02	2.995e-01	8.696e-01
1.0	9.429e+09	3.207e+03	8.385e+03	5.911e+00	1.546e+01
1.5	9.344e+09	6.200e+03	1.363e+04	1.043e+01	2.294e+01
2.0	3.335e+07	3.515e+01	7.007e+01	5.436e-02	1.084e-01
3.0	1.003e-09	1.986e-15	3.501e-15	2.694e-18	4.749e-18
TOTALS:	4.247e+11	6.400e+04	2.069e+05	1.229e+02	3.993e+02

Results - Dose Point # 5 - (192.659,73.5,0) cm					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	1.991e+04	2.681e-131	8.500e-30	2.299e-132	7.291e-31
0.02	3.632e+07	2.067e-59	3.397e-26	7.160e-61	1.177e-27
0.03	2.441e+10	6.264e-18	6.212e-17	6.208e-20	6.156e-19
0.04	6.502e+09	4.290e-08	9.622e-07	1.897e-10	4.255e-09
0.05	1.928e+08	1.377e-05	4.557e-04	3.668e-08	1.214e-06
0.06	2.183e+08	1.298e-03	4.454e-02	2.578e-06	8.847e-05
0.08	5.901e+07	1.735e-02	4.292e-01	2.745e-05	6.792e-04
0.1	7.924e+08	1.187e+00	2.038e+01	1.815e-03	3.118e-02
0.15	2.263e+06	1.674e-02	1.630e-01	2.757e-05	2.684e-04
0.2	1.834e+08	2.701e+00	1.950e+01	4.766e-03	3.442e-02
0.3	2.741e+08	8.675e+00	4.533e+01	1.646e-02	8.598e-02
0.4	1.717e+08	8.892e+00	3.836e+01	1.733e-02	7.474e-02
0.5	1.448e+07	1.089e+00	4.092e+00	2.137e-03	8.032e-03
0.6	3.724e+11	3.789e+04	1.282e+05	7.395e+01	2.503e+02
0.8	6.701e+08	1.097e+02	3.184e+02	2.086e-01	6.056e-01
1.0	9.429e+09	2.234e+03	5.841e+03	4.117e+00	1.077e+01
1.5	9.344e+09	4.319e+03	9.506e+03	7.267e+00	1.599e+01
2.0	3.335e+07	2.450e+01	4.889e+01	3.788e-02	7.561e-02
3.0	1.003e-09	1.385e-15	2.445e-15	1.879e-18	3.317e-18
TOTALS:	4.247e+11	4.460e+04	1.441e+05	8.563e+01	2.779e+02

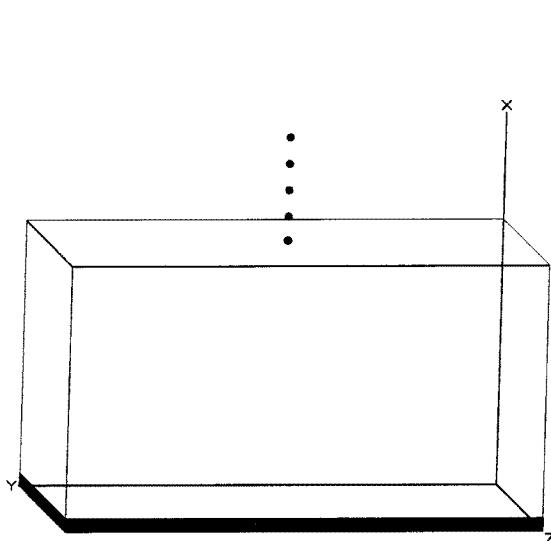
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
 DOS File : VTANK V-3 vessel 652gal decayed 8yr no H2O shield.ms6
 Run Date: August 24, 2004
 Run Time: 10:22:06 AM
 Duration : 00:00:30

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: VTANK V-3 vessel
Description: 652 gal batch decayed 8 yrs no H2O shield @ 1' steps
Geometry: 13 - Rectangular Volume



Source Dimensions			
Length	14.75 cm	5.8 in	
Width	304.8 cm	10 ft 0.0 in	
Height	548.64 cm	18 ft	

Dose Points			
# 1	X 308.9024 cm 10 ft 1.6 in	Y 274.32 cm 9 ft	Z 152.4 cm 5 ft 0.0 in
# 2	336.8424 cm 11 ft 0.6 in	274.32 cm 9 ft	152.4 cm 5 ft 0.0 in
# 3	367.3224 cm 12 ft 0.6 in	274.32 cm 9 ft	152.4 cm 5 ft 0.0 in
# 4	397.8024 cm 13 ft 0.6 in	274.32 cm 9 ft	152.4 cm 5 ft 0.0 in
# 5	428.2824 cm 14 ft 0.6 in	274.32 cm 9 ft	152.4 cm 5 ft 0.0 in

Shields			
Shield Name	Dimension	Material	Density
Source	87.106 ft ³	V123 SLUDGE	1.02
Shield 1	9.536 ft	Air	0.00122
Shield 2	.031 ft	Iron	7.86
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	3.6252e-006	1.3413e+005	1.4697e-006	5.4380e-002
Ac-227	3.1505e-009	1.1657e+002	1.2773e-009	4.7259e-005
Ac-228	1.7993e-019	6.6573e-009	7.2946e-020	2.6990e-015
Ag-108	1.8429e-004	6.8186e+006	7.4713e-005	2.7644e+000
Ag-108m	1.9816e-003	7.3318e+007	8.0337e-004	2.9725e+001
Ag-110	1.4842e-008	5.4917e+002	6.0174e-009	2.2264e-004
Ag-110m	1.1160e-006	4.1291e+004	4.5244e-007	1.6740e-002
Am-241	1.5401e-002	5.6984e+008	6.2439e-003	2.3103e+002
Am-243	7.1748e-009	2.6547e+002	2.9088e-009	1.0763e-004
At-217	3.6252e-006	1.3413e+005	1.4697e-006	5.4380e-002
Ba-137m	1.2988e+001	4.8057e+011	5.2657e+000	1.9483e+005
Bi-210	1.3917e-003	5.1494e+007	5.6424e-004	2.0877e+001
Bi-211	3.0620e-009	1.1330e+002	1.2414e-009	4.5932e-005
Bi-212	8.2187e-020	3.0409e-009	3.3320e-020	1.2328e-015
Bi-213	3.6252e-006	1.3413e+005	1.4697e-006	5.4380e-002
Bi-214	6.3268e-003	2.3409e+008	2.5650e-003	9.4906e+001
Ce-144	2.3681e-005	8.7619e+005	9.6007e-006	3.5523e-001
Cm-242	4.2798e-010	1.5835e+001	1.7351e-010	6.4199e-006
Cm-243	3.6056e-003	1.3341e+008	1.4618e-003	5.4086e+001
Cm-244	3.2247e-003	1.1932e+008	1.3074e-003	4.8373e+001
Co-58	1.3829e-015	5.1169e-005	5.6067e-016	2.0745e-011
Co-60	1.4249e-001	5.2720e+009	5.7767e-002	2.1374e+003

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK V-3 vessel 652gal decayed 8yr no H₂O shield.ms6
Run Date: August 24, 2004
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Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/ cm^3
Cs-134	2.2418e-004	8.2947e+006	9.0888e-005	3.3628e+000
Cs-137	1.3730e+001	5.0800e+011	5.5663e+000	2.0595e+005
Eu-152	2.6473e-002	9.7951e+008	1.0733e-002	3.9711e+002
Eu-154	3.6424e-002	1.3477e+009	1.4767e-002	5.4639e+002
Eu-155	3.0634e-003	1.1335e+008	1.2420e-003	4.5953e+001
Fr-221	3.6252e-006	1.3413e+005	1.4697e-006	5.4380e-002
Fr-223	4.3476e-011	1.6086e+000	1.7626e-011	6.5217e-007
Gd-152	4.5805e-016	1.6948e-005	1.8570e-016	6.8711e-012
I-129	1.5300e-004	5.6610e+006	6.2029e-005	2.2951e+000
Mn-54	1.9998e-006	7.3994e+004	8.1077e-007	2.9999e-002
Nb-95	3.2292e-016	1.1948e-005	1.3092e-016	4.8439e-012
Nb-95m	1.2384e-018	4.5820e-008	5.0206e-019	1.8576e-014
Ni-63	1.9679e+000	7.2813e+010	7.9783e-001	2.9520e+004
Np-237	6.4640e-005	2.3917e+006	2.6206e-005	9.6964e-001
Np-239	7.1673e-009	2.6519e+002	2.9058e-009	1.0751e-004
Pa-231	2.6897e-008	9.9519e+002	1.0905e-008	4.0347e-004
Pa-233	6.4639e-005	2.3917e+006	2.6206e-005	9.6963e-001
Pa-234	2.3840e-007	8.8208e+003	9.6652e-008	3.5761e-003
Pa-234m	1.4900e-004	5.5130e+006	6.0408e-005	2.2351e+000
Pb-209	3.6249e-006	1.3412e+005	1.4696e-006	5.4376e-002
Pb-210	1.3948e-003	5.1607e+007	5.6547e-004	2.0922e+001
Pb-211	3.0620e-009	1.1330e+002	1.2414e-009	4.5932e-005
Pb-212	8.2193e-020	3.0411e-009	3.3323e-020	1.2329e-015
Pb-214	6.3268e-003	2.3409e+008	2.5650e-003	9.4906e+001
Po-210	1.3063e-003	4.8332e+007	5.2959e-004	1.9595e+001
Po-211	8.3593e-012	3.0930e-001	3.3890e-012	1.2539e-007
Po-212	5.2657e-020	1.9483e-009	2.1348e-020	7.8988e-016
Po-213	3.5469e-006	1.3123e+005	1.4380e-006	5.3205e-002
Po-214	6.3255e-003	2.3404e+008	2.5645e-003	9.4886e+001
Po-215	3.0621e-009	1.1330e+002	1.2414e-009	4.5933e-005
Po-216	8.2253e-020	3.0434e-009	3.3347e-020	1.2338e-015
Po-218	6.3281e-003	2.3414e+008	2.5655e-003	9.4925e+001
Pr-144	2.3682e-005	8.7622e+005	9.6011e-006	3.5524e-001
Pr-144m	3.3864e-007	1.2530e+004	1.3729e-007	5.0798e-003
Pu-238	2.7318e-002	1.0108e+009	1.1075e-002	4.0979e+002
Pu-239	1.4997e-002	5.5491e+008	6.0803e-003	2.2497e+002
Pu-240	1.4991e-002	5.5465e+008	6.0775e-003	2.2487e+002
Ra-223	3.0621e-009	1.1330e+002	1.2414e-009	4.5933e-005
Ra-224	8.2254e-020	3.0434e-009	3.3347e-020	1.2339e-015
Ra-225	3.6433e-006	1.3480e+005	1.4771e-006	5.4652e-002
Ra-226	6.3280e-003	2.3414e+008	2.5655e-003	9.4924e+001
Ra-228	1.7999e-019	6.6596e-009	7.2972e-020	2.6999e-015
Rh-103m	1.5705e-024	5.8107e-014	6.3670e-025	2.3558e-020
Rh-106	1.1843e-004	4.3818e+006	4.8013e-005	1.7765e+000
Rn-219	3.0621e-009	1.1330e+002	1.2414e-009	4.5933e-005
Rn-220	8.2253e-020	3.0434e-009	3.3347e-020	1.2338e-015
Rn-222	6.3281e-003	2.3414e+008	2.5655e-003	9.4925e+001
Ru-103	1.5731e-024	5.8203e-014	6.3775e-025	2.3597e-020
Ru-106	1.1843e-004	4.3818e+006	4.8013e-005	1.7765e+000
Sb-125	1.5805e-003	5.8477e+007	6.4075e-004	2.3708e+001
Sr-90	3.8799e+001	1.4356e+012	1.5730e+001	5.8200e+005
Te-125m	3.8729e-004	1.4330e+007	1.5702e-004	5.8096e+000
Th-227	3.0523e-009	1.1294e+002	1.2375e-009	4.5787e-005
Th-228	8.2755e-020	3.0619e-009	3.3551e-020	1.2414e-015
Th-229	3.6702e-006	1.3580e+005	1.4880e-006	5.5054e-002
Th-230	3.5000e-007	1.2950e+004	1.4190e-007	5.2502e-003
Th-231	1.5900e-004	5.8830e+006	6.4462e-005	2.3851e+000
Th-232	7.0086e-019	2.5932e-008	2.8414e-019	1.0513e-014
Th-234	1.4900e-004	5.5130e+006	6.0408e-005	2.2351e+000
Tl-207	3.0537e-009	1.1299e+002	1.2380e-009	4.5807e-005

ENGINEERING DESIGN FILE

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DOS File : VTANK V-3 vessel 652gal decayed 8yr no H₂O shield.ms6
Run Date: August 24, 2004
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<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Tl-208	2.9530e-020	1.0926e-009	1.1972e-020	4.4296e-016
Tl-209	7.8304e-008	2.8972e+003	3.1746e-008	1.1746e-003
U-233	4.8598e-003	1.7981e+008	1.9703e-003	7.2900e+001
U-234	4.8605e-003	1.7984e+008	1.9706e-003	7.2911e+001
U-235	1.5900e-004	5.8830e+006	6.4462e-005	2.3851e+000
U-236	3.5512e-009	1.3140e+002	1.4397e-009	5.3270e-005
U-238	1.4900e-004	5.5130e+006	6.0408e-005	2.2351e+000
Y-90	3.8809e+001	1.4359e+012	1.5734e+001	5.8215e+005
Zn-65	8.1562e-007	3.0178e+004	3.3067e-007	1.2235e-002
Zr-95	1.4607e-016	5.4047e-006	5.9221e-017	2.1912e-012

Buildup
The material reference is : Source

Integration Parameters

X Direction	21
Y Direction	21
Z Direction	21

Results - Dose Point # 1 - (1.01e+01,9,5) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+09	1.038e-186	7.678e-25	8.903e-188	6.585e-26
0.02	4.819e+07	1.916e-86	1.379e-26	6.636e-88	4.775e-28
0.03	2.837e+10	2.976e-26	5.221e-23	2.950e-28	5.175e-25
0.04	7.558e+09	1.433e-11	4.667e-10	6.339e-14	2.064e-12
0.05	2.265e+08	2.799e-07	1.466e-05	7.456e-10	3.905e-08
0.06	2.082e+08	1.339e-04	7.426e-03	2.659e-07	1.475e-05
0.08	9.553e+07	1.291e-02	4.780e-01	2.043e-05	7.565e-04
0.1	9.149e+08	1.027e+00	2.338e+01	1.572e-03	3.578e-02
0.15	1.658e+06	1.280e-02	1.302e-01	2.108e-05	2.144e-04
0.2	2.173e+08	3.572e+00	2.415e+01	6.305e-03	4.262e-02
0.3	3.344e+08	1.208e+01	5.380e+01	2.291e-02	1.021e-01
0.4	2.451e+08	1.437e+01	5.074e+01	2.799e-02	9.887e-02
0.5	1.974e+07	1.653e+00	4.975e+00	3.246e-03	9.764e-03
0.6	4.328e+11	4.817e+04	1.288e+05	9.403e+01	2.514e+02
0.8	7.964e+08	1.374e+02	3.096e+02	2.614e-01	5.889e-01
1.0	6.179e+09	1.488e+03	3.008e+03	2.743e+00	5.545e+00
1.5	6.070e+09	2.626e+03	4.464e+03	4.418e+00	7.510e+00
2.0	6.265e+07	4.022e+01	6.240e+01	6.219e-02	9.649e-02
3.0	1.090e-09	1.185e-15	1.659e-15	1.607e-18	2.250e-18
TOTALS:	4.900e+11	5.250e+04	1.368e+05	1.016e+02	2.654e+02

Results - Dose Point # 2 - (1.11e+01,9,5) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>MeV/cm²/sec</u>	<u>mR/hr</u>	<u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+09	9.840e-187	6.667e-25	8.440e-188	5.719e-26
0.02	4.819e+07	1.869e-86	1.197e-26	6.475e-88	4.147e-28
0.03	2.837e+10	2.942e-26	4.534e-23	2.916e-28	4.494e-25
0.04	7.558e+09	1.411e-11	4.593e-10	6.242e-14	2.032e-12
0.05	2.265e+08	2.713e-07	1.417e-05	7.226e-10	3.775e-08
0.06	2.082e+08	1.274e-04	7.027e-03	2.530e-07	1.396e-05
0.08	9.553e+07	1.193e-02	4.369e-01	1.888e-05	6.914e-04
0.1	9.149e+08	9.335e-01	2.097e+01	1.428e-03	3.208e-02
0.15	1.658e+06	1.144e-02	1.148e-01	1.884e-05	1.891e-04

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Run Date: August 24, 2004
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<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.2	2.173e+08	3.177e+00	2.121e+01	5.608e-03	3.743e-02
0.3	3.344e+08	1.070e+01	4.712e+01	2.029e-02	8.939e-02
0.4	2.451e+08	1.270e+01	4.440e+01	2.475e-02	8.651e-02
0.5	1.974e+07	1.460e+00	4.351e+00	2.865e-03	8.540e-03
0.6	4.328e+11	4.248e+04	1.126e+05	8.293e+01	2.197e+02
0.8	7.964e+08	1.210e+02	2.705e+02	2.302e-01	5.146e-01
1.0	6.179e+09	1.309e+03	2.627e+03	2.412e+00	4.843e+00
1.5	6.070e+09	2.305e+03	3.896e+03	3.878e+00	6.555e+00
2.0	6.265e+07	3.526e+01	5.444e+01	5.452e-02	8.419e-02
3.0	1.090e-09	1.037e-15	1.446e-15	1.407e-18	1.962e-18
TOTALS:	4.900e+11	4.628e+04	1.196e+05	8.956e+01	2.320e+02

Results - Dose Point # 3 - (1.21e+01,9,5) ft					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+09	9.286e-187	5.768e-25	7.965e-188	4.947e-26
0.02	4.819e+07	1.820e-86	1.036e-26	6.303e-88	3.587e-28
0.03	2.837e+10	2.905e-26	3.923e-23	2.879e-28	3.888e-25
0.04	7.558e+09	1.383e-11	4.500e-10	6.118e-14	1.990e-12
0.05	2.265e+08	2.609e-07	1.360e-05	6.951e-10	3.622e-08
0.06	2.082e+08	1.201e-04	6.588e-03	2.386e-07	1.309e-05
0.08	9.553e+07	1.092e-02	3.957e-01	1.728e-05	6.262e-04
0.1	9.149e+08	8.408e-01	1.865e+01	1.286e-03	2.854e-02
0.15	1.658e+06	1.015e-02	1.007e-01	1.672e-05	1.658e-04
0.2	2.173e+08	2.806e+00	1.852e+01	4.953e-03	3.269e-02
0.3	3.344e+08	9.415e+00	4.107e+01	1.786e-02	7.790e-02
0.4	2.451e+08	1.116e+01	3.866e+01	2.174e-02	7.533e-02
0.5	1.974e+07	1.281e+00	3.786e+00	2.514e-03	7.432e-03
0.6	4.328e+11	3.725e+04	9.796e+04	7.270e+01	1.912e+02
0.8	7.964e+08	1.059e+02	2.353e+02	2.015e-01	4.475e-01
1.0	6.179e+09	1.145e+03	2.284e+03	2.110e+00	4.211e+00
1.5	6.070e+09	2.012e+03	3.385e+03	3.386e+00	5.696e+00
2.0	6.265e+07	3.075e+01	4.729e+01	4.755e-02	7.312e-02
3.0	1.090e-09	9.035e-16	1.256e-15	1.226e-18	1.704e-18
TOTALS:	4.900e+11	4.056e+04	1.040e+05	7.849e+01	2.018e+02

Results - Dose Point # 4 - (1.31e+01,9,5) ft					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+09	8.768e-187	5.033e-25	7.520e-188	4.317e-26
0.02	4.819e+07	1.771e-86	9.037e-27	6.136e-88	3.130e-28
0.03	2.837e+10	2.865e-26	3.423e-23	2.840e-28	3.392e-25
0.04	7.558e+09	1.351e-11	4.392e-10	5.976e-14	1.943e-12
0.05	2.265e+08	2.499e-07	1.299e-05	6.658e-10	3.460e-08
0.06	2.082e+08	1.129e-04	6.155e-03	2.242e-07	1.223e-05
0.08	9.553e+07	9.983e-03	3.585e-01	1.580e-05	5.673e-04
0.1	9.149e+08	7.580e-01	1.665e+01	1.160e-03	2.547e-02
0.15	1.658e+06	9.039e-03	8.878e-02	1.489e-05	1.462e-04
0.2	2.173e+08	2.488e+00	1.628e+01	4.392e-03	2.874e-02
0.3	3.344e+08	8.325e+00	3.604e+01	1.579e-02	6.836e-02
0.4	2.451e+08	9.853e+00	3.390e+01	1.920e-02	6.606e-02
0.5	1.974e+07	1.130e+00	3.319e+00	2.218e-03	6.515e-03

ENGINEERING DESIGN FILE

Page : 5
DOS File : VTANK V-3 vessel 652gal decayed 8yr no H₂O shield.ms6
Run Date: August 24, 2004
Run Time: 10:22:06 AM
Duration : 00:00:30

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.6	4.328e+11	3.283e+04	8.585e+04	6.409e+01	1.676e+02
0.8	7.964e+08	9.330e+01	2.061e+02	1.775e-01	3.920e-01
1.0	6.179e+09	1.007e+03	2.001e+03	1.856e+00	3.688e+00
1.5	6.070e+09	1.768e+03	2.964e+03	2.975e+00	4.987e+00
2.0	6.265e+07	2.700e+01	4.139e+01	4.175e-02	6.400e-02
3.0	1.090e-09	7.926e-16	1.099e-15	1.075e-18	1.491e-18
TOTALS:	4.900e+11	3.575e+04	9.117e+04	6.918e+01	1.769e+02

Results - Dose Point # 5 - (1.41e+01,9,5) ft					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+09	8.282e-187	4.425e-25	7.104e-188	3.796e-26
0.02	4.819e+07	1.724e-86	7.946e-27	5.973e-88	2.752e-28
0.03	2.837e+10	2.824e-26	3.009e-23	2.799e-28	2.983e-25
0.04	7.558e+09	1.316e-11	4.273e-10	5.818e-14	1.890e-12
0.05	2.265e+08	2.386e-07	1.236e-05	6.355e-10	3.294e-08
0.06	2.082e+08	1.057e-04	5.737e-03	2.100e-07	1.139e-05
0.08	9.553e+07	9.123e-03	3.250e-01	1.444e-05	5.144e-04
0.1	9.149e+08	6.845e-01	1.490e+01	1.047e-03	2.280e-02
0.15	1.658e+06	8.075e-03	7.871e-02	1.330e-05	1.296e-04
0.2	2.173e+08	2.216e+00	1.440e+01	3.911e-03	2.542e-02
0.3	3.344e+08	7.396e+00	3.182e+01	1.403e-02	6.037e-02
0.4	2.451e+08	8.744e+00	2.993e+01	1.704e-02	5.831e-02
0.5	1.974e+07	1.002e+00	2.929e+00	1.967e-03	5.749e-03
0.6	4.328e+11	2.910e+04	7.574e+04	5.680e+01	1.478e+02
0.8	7.964e+08	8.263e+01	1.818e+02	1.572e-01	3.458e-01
1.0	6.179e+09	8.913e+02	1.764e+03	1.643e+00	3.252e+00
1.5	6.070e+09	1.564e+03	2.613e+03	2.631e+00	4.396e+00
2.0	6.265e+07	2.386e+01	3.648e+01	3.689e-02	5.641e-02
3.0	1.090e-09	6.998e-16	9.684e-16	9.495e-19	1.314e-18
TOTALS:	4.900e+11	3.168e+04	8.043e+04	6.131e+01	1.561e+02

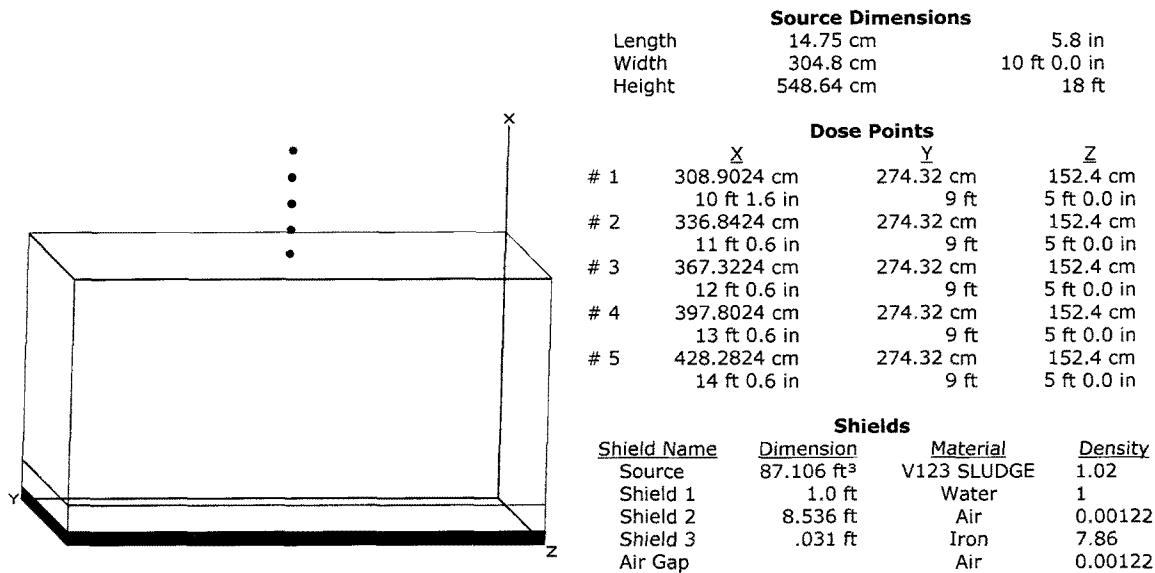
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
DOS File : VTANK V-3 vessel 652gal decayed 8yr 1ft of H2O shield.ms6
Run Date: August 24, 2004
Run Time: 10:54:57 AM
Duration : 00:00:31

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: VTANK V-3 vessel
Description: 652 gal batch decayed 8 yrs 1ft H2O shield @ 1' steps
Geometry: 13 - Rectangular Volume



Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	3.6252e-006	1.3413e+005	1.4697e-006	5.4380e-002
Ac-227	3.1505e-009	1.1657e+002	1.2773e-009	4.7259e-005
Ac-228	1.7993e-019	6.6573e-009	7.2946e-020	2.6990e-015
Ag-108	1.8429e-004	6.8186e+006	7.4713e-005	2.7644e+000
Ag-108m	1.9816e-003	7.3318e+007	8.0337e-004	2.9725e+001
Ag-110	1.4842e-008	5.4917e+002	6.0174e-009	2.2264e-004
Ag-110m	1.1160e-006	4.1291e+004	4.5244e-007	1.6740e-002
Am-241	1.5401e-002	5.6984e+008	6.2439e-003	2.3103e+002
Am-243	7.1748e-009	2.6547e+002	2.9088e-009	1.0763e-004
At-217	3.6252e-006	1.3413e+005	1.4697e-006	5.4380e-002
Ba-137m	1.2988e+001	4.8057e+011	5.2657e+000	1.9483e+005
Bi-210	1.3917e-003	5.1494e+007	5.6424e-004	2.0877e+001
Bi-211	3.0620e-009	1.1330e+002	1.2414e-009	4.5932e-005
Bi-212	8.2187e-020	3.0409e-009	3.3320e-020	1.2328e-015
Bi-213	3.6252e-006	1.3413e+005	1.4697e-006	5.4380e-002
Bi-214	6.3268e-003	2.3409e+008	2.5650e-003	9.4906e+001
Ce-144	2.3681e-005	8.7619e+005	9.6007e-006	3.5523e-001
Cm-242	4.2798e-010	1.5835e+001	1.7351e-010	6.4199e-006
Cm-243	3.6056e-003	1.3341e+008	1.4618e-003	5.4086e+001
Cm-244	3.2247e-003	1.1932e+008	1.3074e-003	4.8373e+001
Co-58	1.3829e-015	5.1169e-005	5.6067e-016	2.0745e-011

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK V-3 vessel 652gal decayed 8yr 1ft of H2O shield.ms6
Run Date: August 24, 2004
Run Time: 10:54:57 AM
Duration : 00:00:31

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/ cm^3
Co-60	1.4249e-001	5.2720e+009	5.7767e-002	2.1374e+003
Cs-134	2.2418e-004	8.2947e+006	9.0888e-005	3.3628e+000
Cs-137	1.3730e+001	5.0800e+011	5.5663e+000	2.0595e+005
Eu-152	2.6473e-002	9.7951e+008	1.0733e-002	3.9711e+002
Eu-154	3.6424e-002	1.3477e+009	1.4767e-002	5.4639e+002
Eu-155	3.0634e-003	1.1335e+008	1.2420e-003	4.5953e+001
Fr-221	3.6252e-006	1.3413e+005	1.4697e-006	5.4380e-002
Fr-223	4.3476e-011	1.6086e+000	1.7626e-011	6.5217e-007
Gd-152	4.5805e-016	1.6948e-005	1.8570e-016	6.8711e-012
I-129	1.5300e-004	5.6610e+006	6.2029e-005	2.2951e+000
Mn-54	1.9998e-006	7.3994e+004	8.1077e-007	2.9999e-002
Nb-95	3.2292e-016	1.1948e-005	1.3092e-016	4.8439e-012
Nb-95m	1.2384e-018	4.5820e-008	5.0206e-019	1.8576e-014
Ni-63	1.9679e+000	7.2813e+010	7.9783e-001	2.9520e+004
Np-237	6.4640e-005	2.3917e+006	2.6206e-005	9.6964e-001
Np-239	7.1673e-009	2.6519e+002	2.9058e-009	1.0751e-004
Pa-231	2.6897e-008	9.9519e+002	1.0905e-008	4.0347e-004
Pa-233	6.4639e-005	2.3917e+006	2.6206e-005	9.6963e-001
Pa-234	2.3840e-007	8.8208e+003	9.6652e-008	3.5761e-003
Pa-234m	1.4900e-004	5.5130e+006	6.0408e-005	2.2351e+000
Pb-209	3.6249e-006	1.3412e+005	1.4696e-006	5.4376e-002
Pb-210	1.3948e-003	5.1607e+007	5.6547e-004	2.0922e+001
Pb-211	3.0620e-009	1.1330e+002	1.2414e-009	4.5932e-005
Pb-212	8.2193e-020	3.0411e-009	3.3323e-020	1.2329e-015
Pb-214	6.3268e-003	2.3409e+008	2.5650e-003	9.4906e+001
Po-210	1.3063e-003	4.8332e+007	5.2959e-004	1.9595e+001
Po-211	8.3593e-012	3.0930e-001	3.3890e-012	1.2539e-007
Po-212	5.2657e-020	1.9483e-009	2.1348e-020	7.8988e-016
Po-213	3.5469e-006	1.3123e+005	1.4380e-006	5.3205e-002
Po-214	6.3255e-003	2.3404e+008	2.5645e-003	9.4886e+001
Po-215	3.0621e-009	1.1330e+002	1.2414e-009	4.5933e-005
Po-216	8.2253e-020	3.0434e-009	3.3347e-020	1.2338e-015
Po-218	6.3281e-003	2.3414e+008	2.5655e-003	9.4925e+001
Pr-144	2.3682e-005	8.7622e+005	9.6011e-006	3.5524e-001
Pr-144m	3.3864e-007	1.2530e+004	1.3729e-007	5.0798e-003
Pu-238	2.7318e-002	1.0108e+009	1.1075e-002	4.0979e+002
Pu-239	1.4997e-002	5.5491e+008	6.0803e-003	2.2497e+002
Pu-240	1.4991e-002	5.5465e+008	6.0775e-003	2.2487e+002
Ra-223	3.0621e-009	1.1330e+002	1.2414e-009	4.5933e-005
Ra-224	8.2254e-020	3.0434e-009	3.3347e-020	1.2339e-015
Ra-225	3.6433e-006	1.3480e+005	1.4771e-006	5.4652e-002
Ra-226	6.3280e-003	2.3414e+008	2.5655e-003	9.4924e+001
Ra-228	1.7999e-019	6.6596e-009	7.2972e-020	2.6999e-015
Rh-103m	1.5705e-024	5.8107e-014	6.3670e-025	2.3558e-020
Rh-106	1.1843e-004	4.3818e+006	4.8013e-005	1.7765e+000
Rn-219	3.0621e-009	1.1330e+002	1.2414e-009	4.5933e-005
Rn-220	8.2253e-020	3.0434e-009	3.3347e-020	1.2338e-015
Rn-222	6.3281e-003	2.3414e+008	2.5655e-003	9.4925e+001
Ru-103	1.5731e-024	5.8203e-014	6.3775e-025	2.3597e-020
Ru-106	1.1843e-004	4.3818e+006	4.8013e-005	1.7765e+000
Sb-125	1.5805e-003	5.8477e+007	6.4075e-004	2.3708e+001
Sr-90	3.8799e+001	1.4356e+012	1.5730e+001	5.8200e+005
Te-125m	3.8729e-004	1.4330e+007	1.5702e-004	5.8096e+000
Th-227	3.0523e-009	1.1294e+002	1.2375e-009	4.5787e-005
Th-228	8.2755e-020	3.0619e-009	3.3551e-020	1.2414e-015
Th-229	3.6702e-006	1.3580e+005	1.4880e-006	5.5054e-002
Th-230	3.5000e-007	1.2950e+004	1.4190e-007	5.2502e-003
Th-231	1.5900e-004	5.8830e+006	6.4462e-005	2.3851e+000
Th-232	7.0086e-019	2.5932e-008	2.8414e-019	1.0513e-014
Th-234	1.4900e-004	5.5130e+006	6.0408e-005	2.2351e+000

ENGINEERING DESIGN FILE

Page : 3
 DOS File : VTANK V-3 vessel 652gal decayed 8yr 1ft of H₂O shield.ms6
 Run Date: August 24, 2004
 Run Time: 10:54:57 AM
 Duration : 00:00:31

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
TI-207	3.0537e-009	1.1299e+002	1.2380e-009	4.5807e-005
TI-208	2.9530e-020	1.0926e-009	1.1972e-020	4.4296e-016
TI-209	7.8304e-008	2.8972e+003	3.1746e-008	1.1746e-003
U-233	4.8598e-003	1.7981e+008	1.9703e-003	7.2900e+001
U-234	4.8605e-003	1.7984e+008	1.9706e-003	7.2911e+001
U-235	1.5900e-004	5.8830e+006	6.4462e-005	2.3851e+000
U-236	3.5512e-009	1.3140e+002	1.4397e-009	5.3270e-005
U-238	1.4900e-004	5.5130e+006	6.0408e-005	2.2351e+000
Y-90	3.8809e+001	1.4359e+012	1.5734e+001	5.8215e+005
Zn-65	8.1562e-007	3.0178e+004	3.3067e-007	1.2235e-002
Zr-95	1.4607e-016	5.4047e-006	5.9221e-017	2.1912e-012

Buildup
The material reference is : Shield 1

Integration Parameters

X Direction	21
Y Direction	21
Z Direction	21

Results - Dose Point # 1 - (1.01e+01,9,5) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+09	1.238e-207	1.004e-24	1.062e-208	8.612e-26
0.02	4.819e+07	2.043e-96	2.492e-26	7.078e-98	8.632e-28
0.03	2.837e+10	6.868e-31	3.177e-22	6.807e-33	3.149e-24
0.04	7.558e+09	5.572e-15	1.196e-12	2.464e-17	5.290e-15
0.05	2.265e+08	2.942e-10	1.195e-07	7.837e-13	3.184e-10
0.06	2.082e+08	2.254e-07	1.055e-04	4.477e-10	2.096e-07
0.08	9.553e+07	3.568e-05	1.326e-02	5.647e-08	2.098e-05
0.1	9.149e+08	3.894e-03	1.023e+00	5.957e-06	1.565e-03
0.15	1.658e+06	8.529e-05	1.076e-02	1.405e-07	1.773e-05
0.2	2.173e+08	3.609e-02	2.658e+00	6.369e-05	4.691e-03
0.3	3.344e+08	2.190e-01	7.877e+00	4.154e-04	1.494e-02
0.4	2.451e+08	3.931e-01	8.743e+00	7.660e-04	1.704e-02
0.5	1.974e+07	6.154e-02	9.671e-01	1.208e-04	1.898e-03
0.6	4.328e+11	2.284e+03	2.760e+04	4.459e+00	5.388e+01
0.8	7.964e+08	9.385e+00	7.692e+01	1.785e-02	1.463e-01
1.0	6.179e+09	1.328e+02	8.298e+02	2.447e-01	1.530e+00
1.5	6.070e+09	3.654e+02	1.496e+03	6.149e-01	2.516e+00
2.0	6.265e+07	7.382e+00	2.368e+01	1.142e-02	3.662e-02
3.0	1.090e-09	3.027e-16	7.324e-16	4.107e-19	9.937e-19
TOTALS:	4.900e+11	2.800e+03	3.005e+04	5.349e+00	5.815e+01

Results - Dose Point # 2 - (1.11e+01,9,5) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+09	1.174e-207	8.718e-25	1.007e-208	7.478e-26
0.02	4.819e+07	1.994e-96	2.164e-26	6.906e-98	7.496e-28
0.03	2.837e+10	6.791e-31	2.759e-22	6.730e-33	2.735e-24
0.04	7.558e+09	5.508e-15	1.182e-12	2.436e-17	5.228e-15
0.05	2.265e+08	2.884e-10	1.170e-07	7.684e-13	3.116e-10
0.06	2.082e+08	2.189e-07	1.020e-04	4.347e-10	2.027e-07
0.08	9.553e+07	3.413e-05	1.257e-02	5.401e-08	1.990e-05
0.1	9.149e+08	3.691e-03	9.581e-01	5.646e-06	1.466e-03

ENGINEERING DESIGN FILE

Page : 4
 DOS File : VTANK V-3 vessel 652gal decayed 8yr 1ft of H₂O shield.ms6
 Run Date: August 24, 2004
 Run Time: 10:54:57 AM
 Duration : 00:00:31

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.15	1.658e+06	7.996e-05	9.941e-03	1.317e-07	1.637e-05
0.2	2.173e+08	3.364e-02	2.439e+00	5.938e-05	4.305e-03
0.3	3.344e+08	2.028e-01	7.181e+00	3.847e-04	1.362e-02
0.4	2.451e+08	3.624e-01	7.938e+00	7.061e-04	1.547e-02
0.5	1.974e+07	5.653e-02	8.753e-01	1.110e-04	1.718e-03
0.6	4.328e+11	2.092e+03	2.493e+04	4.083e+00	4.866e+01
0.8	7.964e+08	8.553e+00	6.920e+01	1.627e-02	1.316e-01
1.0	6.179e+09	1.205e+02	7.444e+02	2.222e-01	1.372e+00
1.5	6.070e+09	3.296e+02	1.335e+03	5.546e-01	2.246e+00
2.0	6.265e+07	6.629e+00	2.107e+01	1.025e-02	3.258e-02
3.0	1.090e-09	2.704e-16	6.492e-16	3.668e-19	8.808e-19
TOTALS:	4.900e+11	2.558e+03	2.712e+04	4.887e+00	5.248e+01

Results - Dose Point # 3 - (1.21e+01,9,5) ft					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+09	1.108e-207	7.543e-25	9.503e-209	6.469e-26
0.02	4.819e+07	1.941e-96	1.872e-26	6.723e-98	6.485e-28
0.03	2.837e+10	6.707e-31	2.387e-22	6.647e-33	2.366e-24
0.04	7.558e+09	5.427e-15	1.164e-12	2.400e-17	5.150e-15
0.05	2.265e+08	2.812e-10	1.138e-07	7.490e-13	3.031e-10
0.06	2.082e+08	2.110e-07	9.788e-05	4.190e-10	1.944e-07
0.08	9.553e+07	3.236e-05	1.181e-02	5.121e-08	1.869e-05
0.1	9.149e+08	3.466e-03	8.891e-01	5.302e-06	1.360e-03
0.15	1.658e+06	7.425e-05	9.096e-03	1.223e-07	1.498e-05
0.2	2.173e+08	3.107e-02	2.218e+00	5.484e-05	3.914e-03
0.3	3.344e+08	1.861e-01	6.489e+00	3.530e-04	1.231e-02
0.4	2.451e+08	3.310e-01	7.145e+00	6.449e-04	1.392e-02
0.5	1.974e+07	5.145e-02	7.857e-01	1.010e-04	1.542e-03
0.6	4.328e+11	1.899e+03	2.233e+04	3.706e+00	4.359e+01
0.8	7.964e+08	7.728e+00	6.177e+01	1.470e-02	1.175e-01
1.0	6.179e+09	1.085e+02	6.628e+02	2.001e-01	1.222e+00
1.5	6.070e+09	2.950e+02	1.183e+03	4.963e-01	1.991e+00
2.0	6.265e+07	5.909e+00	1.862e+01	9.137e-03	2.879e-02
3.0	1.090e-09	2.398e-16	5.719e-16	3.254e-19	7.759e-19
TOTALS:	4.900e+11	2.316e+03	2.428e+04	4.427e+00	4.698e+01

Results - Dose Point # 4 - (1.31e+01,9,5) ft					
<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+09	1.046e-207	6.581e-25	8.970e-209	5.645e-26
0.02	4.819e+07	1.889e-96	1.634e-26	6.545e-98	5.659e-28
0.03	2.837e+10	6.621e-31	2.083e-22	6.562e-33	2.064e-24
0.04	7.558e+09	5.334e-15	1.144e-12	2.359e-17	5.058e-15
0.05	2.265e+08	2.730e-10	1.102e-07	7.273e-13	2.936e-10
0.06	2.082e+08	2.025e-07	9.351e-05	4.022e-10	1.857e-07
0.08	9.553e+07	3.056e-05	1.106e-02	4.837e-08	1.750e-05
0.1	9.149e+08	3.244e-03	8.230e-01	4.963e-06	1.259e-03
0.15	1.658e+06	6.878e-05	8.313e-03	1.133e-07	1.369e-05
0.2	2.173e+08	2.864e-02	2.016e+00	5.055e-05	3.558e-03
0.3	3.344e+08	1.705e-01	5.868e+00	3.235e-04	1.113e-02
0.4	2.451e+08	3.021e-01	6.440e+00	5.887e-04	1.255e-02

ENGINEERING DESIGN FILE

Page : 5
 DOS File : VTANK V-3 vessel 652gal decayed 8yr 1ft of H2O shield.ms6
 Run Date: August 24, 2004
 Run Time: 10:54:57 AM
 Duration : 00:00:31

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.5	1.974e+07	4.682e-02	7.065e-01	9.191e-05	1.387e-03
0.6	4.328e+11	1.723e+03	2.005e+04	3.364e+00	3.913e+01
0.8	7.964e+08	6.989e+00	5.529e+01	1.329e-02	1.052e-01
1.0	6.179e+09	9.786e+01	5.920e+02	1.804e-01	1.091e+00
1.5	6.070e+09	2.646e+02	1.053e+03	4.452e-01	1.771e+00
2.0	6.265e+07	5.283e+00	1.653e+01	8.169e-03	2.556e-02
3.0	1.090e-09	2.136e-16	5.063e-16	2.897e-19	6.869e-19
TOTALS:	4.900e+11	2.099e+03	2.178e+04	4.012e+00	4.215e+01

Results - Dose Point # 5 - (1.41e+01,9,5) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+09	9.876e-208	5.787e-25	8.471e-209	4.963e-26
0.02	4.819e+07	1.839e-96	1.436e-26	6.371e-98	4.975e-28
0.03	2.837e+10	6.533e-31	1.831e-22	6.474e-33	1.815e-24
0.04	7.558e+09	5.228e-15	1.120e-12	2.312e-17	4.954e-15
0.05	2.265e+08	2.642e-10	1.064e-07	7.038e-13	2.834e-10
0.06	2.082e+08	1.937e-07	8.902e-05	3.847e-10	1.768e-07
0.08	9.553e+07	2.878e-05	1.033e-02	4.554e-08	1.635e-05
0.1	9.149e+08	3.028e-03	7.606e-01	4.633e-06	1.164e-03
0.15	1.658e+06	6.360e-05	7.597e-03	1.047e-07	1.251e-05
0.2	2.173e+08	2.637e-02	1.834e+00	4.654e-05	3.237e-03
0.3	3.344e+08	1.562e-01	5.314e+00	2.963e-04	1.008e-02
0.4	2.451e+08	2.758e-01	5.815e+00	5.374e-04	1.133e-02
0.5	1.974e+07	4.264e-02	6.367e-01	8.369e-05	1.250e-03
0.6	4.328e+11	1.566e+03	1.804e+04	3.057e+00	3.521e+01
0.8	7.964e+08	6.330e+00	4.964e+01	1.204e-02	9.441e-02
1.0	6.179e+09	8.841e+01	5.305e+02	1.630e-01	9.779e-01
1.5	6.070e+09	2.380e+02	9.407e+02	4.005e-01	1.583e+00
2.0	6.265e+07	4.739e+00	1.474e+01	7.328e-03	2.279e-02
3.0	1.090e-09	1.909e-16	4.505e-16	2.590e-19	6.112e-19
TOTALS:	4.900e+11	1.904e+03	1.959e+04	3.641e+00	3.792e+01

ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
 DOS File : VTANK V-3 vessel 652gal decayed 8yr 2ft of H2O shield.ms6
 Run Date: August 24, 2004
 Run Time: 10:57:31 AM
 Duration : 00:00:31

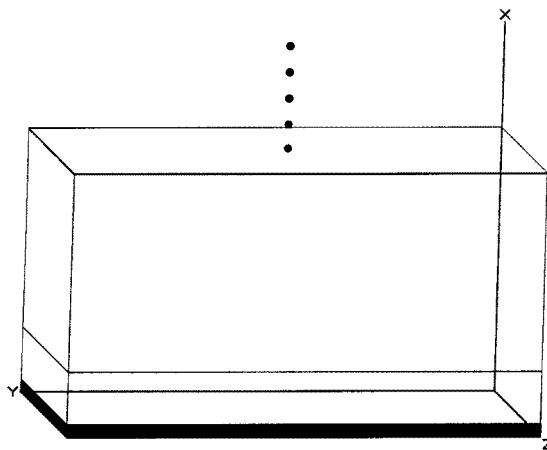
File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: VTANK V-3 vessel
Description: 652 gal batch decayed 8 yrs 2ft H2O shield @ 1' step
Geometry: 13 - Rectangular Volume

Source Dimensions			
	Length	Width	Height
	14.75 cm		5.8 in
	304.8 cm		10 ft 0.0 in
	548.64 cm		18 ft

Dose Points			
#	X	Y	Z
# 1	308.9024 cm 10 ft 1.6 in	274.32 cm 9 ft	152.4 cm 5 ft 0.0 in
# 2	336.8424 cm 11 ft 0.6 in	274.32 cm 9 ft	152.4 cm 5 ft 0.0 in
# 3	367.3224 cm 12 ft 0.6 in	274.32 cm 9 ft	152.4 cm 5 ft 0.0 in
# 4	397.8024 cm 13 ft 0.6 in	274.32 cm 9 ft	152.4 cm 5 ft 0.0 in
# 5	428.2824 cm 14 ft 0.6 in	274.32 cm 9 ft	152.4 cm 5 ft 0.0 in

Shields			
Shield Name	Dimension	Material	Density
Source	87.106 ft ³	V123 SLUDGE	1.02
Shield 1	2.0 ft	Water	1
Shield 2	7.536 ft	Air	0.00122
Shield 3	.031 ft	Iron	7.86
Air Gap		Air	0.00122



Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included
Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	3.6252e-006	1.3413e+005	1.4697e-006	5.4380e-002
Ac-227	3.1505e-009	1.1657e+002	1.2773e-009	4.7259e-005
Ac-228	1.7993e-019	6.6573e-009	7.2946e-020	2.6990e-015
Ag-108	1.8429e-004	6.8186e+006	7.4713e-005	2.7644e+000
Ag-108m	1.9816e-003	7.3318e+007	8.0337e-004	2.9725e+001
Ag-110	1.4842e-008	5.4917e+002	6.0174e-009	2.2264e-004
Ag-110m	1.1160e-006	4.1291e+004	4.5244e-007	1.6740e-002
Am-241	1.5401e-002	5.6984e+008	6.2439e-003	2.3103e+002
Am-243	7.1748e-009	2.6547e+002	2.9088e-009	1.0763e-004
At-217	3.6252e-006	1.3413e+005	1.4697e-006	5.4380e-002
Ba-137m	1.2988e+001	4.8057e+011	5.2657e+000	1.9483e+005
Bi-210	1.3917e-003	5.1494e+007	5.6424e-004	2.0877e+001
Bi-211	3.0620e-009	1.1330e+002	1.2414e-009	4.5932e-005
Bi-212	8.2187e-020	3.0409e-009	3.3320e-020	1.2328e-015
Bi-213	3.6252e-006	1.3413e+005	1.4697e-006	5.4380e-002
Bi-214	6.3268e-003	2.3409e+008	2.5650e-003	9.4906e+001
Ce-144	2.3681e-005	8.7619e+005	9.6007e-006	3.5523e-001
Cm-242	4.2798e-010	1.5835e+001	1.7351e-010	6.4199e-006
Cm-243	3.6056e-003	1.3341e+008	1.4618e-003	5.4086e+001
Cm-244	3.2247e-003	1.1932e+008	1.3074e-003	4.8373e+001
Co-58	1.3829e-015	5.1169e-005	5.6067e-016	2.0745e-011

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK V-3 vessel 652gal decayed 8yr 2ft of H₂O shield.ms6
Run Date: August 24, 2004
Run Time: 10:57:31 AM
Duration : 00:00:31

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Co-60	1.4249e-001	5.2720e+009	5.7767e-002	2.1374e+003
Cs-134	2.2418e-004	8.2947e+006	9.0888e-005	3.3628e+000
Cs-137	1.3730e+001	5.0800e+011	5.5663e+000	2.0595e+005
Eu-152	2.6473e-002	9.7951e+008	1.0733e-002	3.9711e+002
Eu-154	3.6424e-002	1.3477e+009	1.4767e-002	5.4639e+002
Eu-155	3.0634e-003	1.1335e+008	1.2420e-003	4.5953e+001
Fr-221	3.6252e-006	1.3413e+005	1.4697e-006	5.4380e-002
Fr-223	4.3476e-011	1.6086e+000	1.7626e-011	6.5217e-007
Gd-152	4.5805e-016	1.6948e-005	1.8570e-016	6.8711e-012
I-129	1.5300e-004	5.6610e+006	6.2029e-005	2.2951e+000
Mn-54	1.9998e-006	7.3994e+004	8.1077e-007	2.9999e-002
Nb-95	3.2292e-016	1.1948e-005	1.3092e-016	4.8439e-012
Nb-95m	1.2384e-018	4.5820e-008	5.0206e-019	1.8576e-014
Ni-63	1.9679e+000	7.2813e+010	7.9783e-001	2.9520e+004
Np-237	6.4640e-005	2.3917e+006	2.6206e-005	9.6964e-001
Np-239	7.1673e-009	2.6519e+002	2.9058e-009	1.0751e-004
Pa-231	2.6897e-008	9.9519e+002	1.0905e-008	4.0347e-004
Pa-233	6.4639e-005	2.3917e+006	2.6206e-005	9.6963e-001
Pa-234	2.3840e-007	8.8208e+003	9.6652e-008	3.5761e-003
Pa-234m	1.4900e-004	5.5130e+006	6.0408e-005	2.2351e+000
Pb-209	3.6249e-006	1.3412e+005	1.4696e-006	5.4376e-002
Pb-210	1.3948e-003	5.1607e+007	5.6547e-004	2.0922e+001
Pb-211	3.0620e-009	1.1330e+002	1.2414e-009	4.5932e-005
Pb-212	8.2193e-020	3.0411e-009	3.3323e-020	1.2329e-015
Pb-214	6.3268e-003	2.3409e+008	2.5650e-003	9.4906e+001
Po-210	1.3063e-003	4.8332e+007	5.2959e-004	1.9595e+001
Po-211	8.3593e-012	3.0930e-001	3.3890e-012	1.2539e-007
Po-212	5.2657e-020	1.9483e-009	2.1348e-020	7.8988e-016
Po-213	3.5469e-006	1.3123e+005	1.4380e-006	5.3205e-002
Po-214	6.3255e-003	2.3404e+008	2.5645e-003	9.4886e+001
Po-215	3.0621e-009	1.1330e+002	1.2414e-009	4.5933e-005
Po-216	8.2253e-020	3.0434e-009	3.3347e-020	1.2338e-015
Po-218	6.3281e-003	2.3414e+008	2.5655e-003	9.4925e+001
Pr-144	2.3682e-005	8.7622e+005	9.6011e-006	3.5524e-001
Pr-144m	3.3864e-007	1.2530e+004	1.3729e-007	5.0798e-003
Pu-238	2.7318e-002	1.0108e+009	1.1075e-002	4.0979e+002
Pu-239	1.4997e-002	5.5491e+008	6.0803e-003	2.2497e+002
Pu-240	1.4991e-002	5.5465e+008	6.0775e-003	2.2487e+002
Ra-223	3.0621e-009	1.1330e+002	1.2414e-009	4.5933e-005
Ra-224	8.2254e-020	3.0434e-009	3.3347e-020	1.2339e-015
Ra-225	3.6433e-006	1.3480e+005	1.4771e-006	5.4652e-002
Ra-226	6.3280e-003	2.3414e+008	2.5655e-003	9.4924e+001
Ra-228	1.7999e-019	6.6596e-009	7.2972e-020	2.6999e-015
Rh-103m	1.5705e-024	5.8107e-014	6.3670e-025	2.3558e-020
Rh-106	1.1843e-004	4.3818e+006	4.8013e-005	1.7765e+000
Rn-219	3.0621e-009	1.1330e+002	1.2414e-009	4.5933e-005
Rn-220	8.2253e-020	3.0434e-009	3.3347e-020	1.2338e-015
Rn-222	6.3281e-003	2.3414e+008	2.5655e-003	9.4925e+001
Ru-103	1.5731e-024	5.8203e-014	6.3775e-025	2.3597e-020
Ru-106	1.1843e-004	4.3818e+006	4.8013e-005	1.7765e+000
Sb-125	1.5805e-003	5.8477e+007	6.4075e-004	2.3708e+001
Sr-90	3.8799e+001	1.4356e+012	1.5730e+001	5.8200e+005
Te-125m	3.8729e-004	1.4330e+007	1.5702e-004	5.8096e+000
Th-227	3.0523e-009	1.1294e+002	1.2375e-009	4.5787e-005
Th-228	8.2755e-020	3.0619e-009	3.3551e-020	1.2414e-015
Th-229	3.6702e-006	1.3580e+005	1.4880e-006	5.5054e-002
Th-230	3.5000e-007	1.2950e+004	1.4190e-007	5.2502e-003
Th-231	1.5900e-004	5.8830e+006	6.4462e-005	2.3851e+000
Th-232	7.0086e-019	2.5932e-008	2.8414e-019	1.0513e-014
Th-234	1.4900e-004	5.5130e+006	6.0408e-005	2.2351e+000

ENGINEERING DESIGN FILE

Page : 3
DOS File : VTANK V-3 vessel 652gal decayed 8yr 2ft of H₂O shield.ms6
Run Date: August 24, 2004
Run Time: 10:57:31 AM
Duration : 00:00:31

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
TI-207	3.0537e-009	1.1299e+002	1.2380e-009	4.5807e-005
TI-208	2.9530e-020	1.0926e-009	1.1972e-020	4.4296e-016
TI-209	7.8304e-008	2.8972e+003	3.1746e-008	1.1746e-003
U-233	4.8598e-003	1.7981e+008	1.9703e-003	7.2900e+001
U-234	4.8605e-003	1.7984e+008	1.9706e-003	7.2911e+001
U-235	1.5900e-004	5.8830e+006	6.4462e-005	2.3851e+000
U-236	3.5512e-009	1.3140e+002	1.4397e-009	5.3270e-005
U-238	1.4900e-004	5.5130e+006	6.0408e-005	2.2351e+000
Y-90	3.8809e+001	1.4359e+012	1.5734e+001	5.8215e+005
Zn-65	8.1562e-007	3.0178e+004	3.3067e-007	1.2235e-002
Zr-95	1.4607e-016	5.4047e-006	5.9221e-017	2.1912e-012

Buildup
The material reference is : Shield 1

Integration Parameters

X Direction	21
Y Direction	21
Z Direction	21

Results - Dose Point # 1 - (1.01e+01,9,5) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+009	1.491e-228	1.004e-24	1.279e-229	8.612e-26
0.02	4.819e+007	2.205e-106	2.492e-26	7.637e-108	8.632e-28
0.03	2.837e+010	1.619e-35	3.177e-22	1.605e-37	3.149e-24
0.04	7.558e+009	2.262e-18	6.685e-16	1.000e-20	2.956e-18
0.05	2.265e+008	3.316e-13	2.330e-10	8.834e-16	6.208e-13
0.06	2.082e+008	4.172e-10	4.152e-07	8.286e-13	8.247e-10
0.08	9.553e+007	1.116e-07	1.147e-04	1.766e-10	1.815e-07
0.1	9.149e+008	1.685e-05	1.426e-02	2.577e-08	2.181e-05
0.15	1.658e+006	6.446e-07	2.890e-04	1.062e-09	4.759e-07
0.2	2.173e+008	4.082e-04	1.025e-01	7.205e-07	1.809e-04
0.3	3.344e+008	4.356e-03	4.691e-01	8.264e-06	8.899e-04
0.4	2.451e+008	1.163e-02	6.906e-01	2.266e-05	1.346e-03
0.5	1.974e+007	2.450e-03	9.421e-02	4.810e-06	1.849e-04
0.6	4.328e+011	1.149e+02	3.156e+03	2.243e-01	6.160e+00
0.8	7.964e+008	6.722e-01	1.135e+01	1.279e-03	2.160e-02
1.0	6.179e+009	1.232e+01	1.465e+02	2.271e-02	2.701e-01
1.5	6.070e+009	5.228e+01	3.602e+02	8.795e-02	6.060e-01
2.0	6.265e+007	1.383e+000	6.927e+000	2.139e-03	1.071e-02
3.0	1.090e-009	7.845e-17	2.697e-16	1.064e-19	3.659e-19
TOTALS:	4.900e+11	1.816e+02	3.682e+03	3.385e-01	7.071e+00

Results - Dose Point # 2 - (1.11e+01,9,5) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+009	1.415e-228	8.718e-25	1.214e-229	7.478e-26
0.02	4.819e+007	2.151e-106	2.164e-26	7.450e-108	7.496e-28
0.03	2.837e+010	1.601e-35	2.759e-22	1.587e-37	2.735e-24
0.04	7.558e+009	2.240e-18	6.621e-16	9.908e-21	2.928e-18
0.05	2.265e+008	3.271e-13	2.297e-10	8.714e-16	6.118e-13
0.06	2.082e+008	4.092e-10	4.063e-07	8.128e-13	8.070e-10
0.08	9.553e+007	1.086e-07	1.110e-04	1.718e-10	1.756e-07
0.1	9.149e+008	1.629e-05	1.369e-02	2.493e-08	2.095e-05

ENGINEERING DESIGN FILE

Page : 4
 DOS File : VTANK V-3 vessel 652gal decayed 8yr 2ft of H₂O shield.ms6
 Run Date: August 24, 2004
 Run Time: 10:57:31 AM
 Duration : 00:00:31

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.15	1.658e+06	6.189e-07	2.749e-04	1.019e-09	4.526e-07
0.2	2.173e+08	3.902e-04	9.699e-02	6.887e-07	1.712e-04
0.3	3.344e+08	4.138e-03	4.408e-01	7.850e-06	8.361e-04
0.4	2.451e+08	1.099e-02	6.458e-01	2.142e-05	1.258e-03
0.5	1.974e+07	2.308e-03	8.775e-02	4.529e-06	1.722e-04
0.6	4.328e+11	1.079e+02	2.930e+03	2.105e-01	5.718e+00
0.8	7.964e+08	6.272e-01	1.048e+01	1.193e-03	1.994e-02
1.0	6.179e+09	1.145e+01	1.347e+02	2.110e-02	2.483e-01
1.5	6.070e+09	4.814e+01	3.285e+02	8.099e-02	5.527e-01
2.0	6.265e+07	1.266e+00	6.284e+00	1.958e-03	9.717e-03
3.0	1.090e-09	7.124e-17	2.430e-16	9.665e-20	3.296e-19
TOTALS:	4.900e+11	1.694e+02	3.411e+03	3.158e-01	6.551e+00

Results - Dose Point # 3 - (1.21e+01,9,5) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+09	1.336e-228	7.543e-25	1.146e-229	6.469e-26
0.02	4.819e+07	2.094e-106	1.872e-26	7.253e-108	6.485e-28
0.03	2.837e+10	1.582e-35	2.387e-22	1.568e-37	2.366e-24
0.04	7.558e+09	2.214e-18	6.542e-16	9.790e-21	2.893e-18
0.05	2.265e+08	3.213e-13	2.253e-10	8.558e-16	6.001e-13
0.06	2.082e+08	3.992e-10	3.952e-07	7.928e-13	7.849e-10
0.08	9.553e+07	1.048e-07	1.065e-04	1.659e-10	1.686e-07
0.1	9.149e+08	1.564e-05	1.304e-02	2.392e-08	1.995e-05
0.15	1.658e+06	5.893e-07	2.591e-04	9.704e-10	4.266e-07
0.2	2.173e+08	3.698e-04	9.091e-02	6.526e-07	1.605e-04
0.3	3.344e+08	3.896e-03	4.103e-01	7.391e-06	7.783e-04
0.4	2.451e+08	1.030e-02	5.982e-01	2.007e-05	1.166e-03
0.5	1.974e+07	2.153e-03	8.097e-02	4.226e-06	1.589e-04
0.6	4.328e+11	1.003e+02	2.694e+03	1.957e-01	5.259e+00
0.8	7.964e+08	5.799e-01	9.593e+00	1.103e-03	1.825e-02
1.0	6.179e+09	1.053e+01	1.227e+02	1.942e-02	2.262e-01
1.5	6.070e+09	4.394e+01	2.971e+02	7.392e-02	4.998e-01
2.0	6.265e+07	1.149e+00	5.654e+00	1.777e-03	8.743e-03
3.0	1.090e-09	6.417e-17	2.172e-16	8.706e-20	2.947e-19
TOTALS:	4.900e+11	1.565e+02	3.130e+03	2.920e-01	6.014e+00

Results - Dose Point # 4 - (1.31e+01,9,5) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+09	1.260e-228	6.581e-25	1.081e-229	5.645e-26
0.02	4.819e+07	2.038e-106	1.634e-26	7.061e-108	5.659e-28
0.03	2.837e+10	1.562e-35	2.083e-22	1.548e-37	2.064e-24
0.04	7.558e+09	2.183e-18	6.450e-16	9.656e-21	2.853e-18
0.05	2.265e+08	3.145e-13	2.202e-10	8.378e-16	5.865e-13
0.06	2.082e+08	3.878e-10	3.828e-07	7.704e-13	7.603e-10
0.08	9.553e+07	1.008e-07	1.019e-04	1.595e-10	1.612e-07
0.1	9.149e+08	1.495e-05	1.237e-02	2.287e-08	1.893e-05
0.15	1.658e+06	5.588e-07	2.433e-04	9.202e-10	4.007e-07
0.2	2.173e+08	3.491e-04	8.494e-02	6.161e-07	1.499e-04
0.3	3.344e+08	3.655e-03	3.809e-01	6.934e-06	7.225e-04
0.4	2.451e+08	9.618e-03	5.529e-01	1.874e-05	1.077e-03

ENGINEERING DESIGN FILE

Page : 5
 DOS File : VTANK V-3 vessel 652gal decayed 8yr 2ft of H₂O shield.ms6
 Run Date: August 24, 2004
 Run Time: 10:57:31 AM
 Duration : 00:00:31

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.5	1.974e+07	2.003e-03	7.458e-02	3.932e-06	1.464e-04
0.6	4.328e+11	9.301e+01	2.474e+03	1.815e-01	4.829e+00
0.8	7.964e+08	5.351e-01	8.769e+00	1.018e-03	1.668e-02
1.0	6.179e+09	9.682e+00	1.118e+02	1.785e-02	2.060e-01
1.5	6.070e+09	4.008e+01	2.688e+02	6.744e-02	4.523e-01
2.0	6.265e+07	1.043e+00	5.095e+00	1.613e-03	7.878e-03
3.0	1.090e-09	5.789e-17	1.947e-16	7.853e-20	2.642e-19
TOTALS:	4.900e+11	1.444e+02	2.870e+03	2.695e-01	5.514e+00

Results - Dose Point # 5 - (1.41e+01,9,5) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.881e+09	1.190e-228	5.787e-25	1.021e-229	4.963e-26
0.02	4.819e+07	1.984e-106	1.436e-26	6.874e-108	4.975e-28
0.03	2.837e+10	1.542e-35	1.831e-22	1.528e-37	1.815e-24
0.04	7.558e+09	2.149e-18	6.346e-16	9.503e-21	2.807e-18
0.05	2.265e+08	3.069e-13	2.145e-10	8.175e-16	5.713e-13
0.06	2.082e+08	3.755e-10	3.694e-07	7.459e-13	7.338e-10
0.08	9.553e+07	9.657e-08	9.705e-05	1.528e-10	1.536e-07
0.1	9.149e+08	1.423e-05	1.170e-02	2.178e-08	1.789e-05
0.15	1.658e+06	5.282e-07	2.279e-04	8.697e-10	3.753e-07
0.2	2.173e+08	3.285e-04	7.917e-02	5.798e-07	1.397e-04
0.3	3.344e+08	3.420e-03	3.530e-01	6.488e-06	6.695e-04
0.4	2.451e+08	8.962e-03	5.104e-01	1.746e-05	9.945e-04
0.5	1.974e+07	1.860e-03	6.864e-02	3.651e-06	1.347e-04
0.6	4.328e+11	8.613e+01	2.271e+03	1.681e-01	4.433e+00
0.8	7.964e+08	4.933e-01	8.017e+00	9.383e-04	1.525e-02
1.0	6.179e+09	8.893e+00	1.018e+02	1.639e-02	1.877e-01
1.5	6.070e+09	3.658e+01	2.437e+02	6.155e-02	4.099e-01
2.0	6.265e+07	9.480e-01	4.601e+00	1.466e-03	7.115e-03
3.0	1.090e-09	5.232e-17	1.751e-16	7.099e-20	2.375e-19
TOTALS:	4.900e+11	1.331e+02	2.630e+03	2.485e-01	5.055e+00

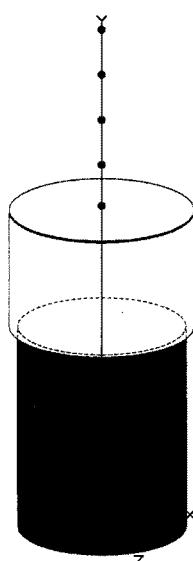
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
 DOS File : VTANK V-9 vessel 320 gal decayed 8yr no shield.ms6
 Run Date: August 24, 2004
 Run Time: 11:12:37 AM
 Duration : 00:00:02

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: Vtank 9 Ext Exposure
Description: 320 gal batch decayed 8 yrs w/o shield@ cont., 1, 2, 3, 4 ft
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions			
		Height	135.331 cm
		Radius	53.34 cm

Dose Points			
#	X	Y	Z
# 1	0 cm	216.5477 cm	0 cm
	0.0 in	7 ft 1.3 in	0.0 in
# 2	0 cm	244.4877 cm	0 cm
	0.0 in	8 ft 0.3 in	0.0 in
# 3	0 cm	274.9677 cm	0 cm
	0.0 in	9 ft 0.3 in	0.0 in
# 4	0 cm	305.4477 cm	0 cm
	0.0 in	10 ft 0.3 in	0.0 in
# 5	0 cm	335.9277 cm	0 cm
	0.0 in	11 ft 0.3 in	0.0 in

Shields				
<u>Shield Name</u>	<u>Dimension</u>	<u>Material</u>	<u>Density</u>	
Source	1.21e+06 cm ³	V123 SLUDGE	1.02	
Shield 1	77.724 cm	Air	0.00122	
Shield 2	.953 cm	Iron	7.86	
Air Gap		Air	0.00122	

Source Input
Grouping Method : Standard Indices

Number of Groups : 25

Lower Energy Cutoff : 0.015

Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	8.5036e-006	3.1463e+005	7.0299e-006	2.6011e-001
Ac-227	7.4304e-009	2.7492e+002	6.1427e-009	2.2728e-004
Ac-228	9.2959e-020	3.4395e-009	7.6849e-020	2.8434e-015
Am-241	5.2621e-003	1.9470e+008	4.3501e-003	1.6095e+002
Am-243	1.0091e-009	3.7335e+001	8.3419e-010	3.0865e-005
At-217	8.5036e-006	3.1463e+005	7.0299e-006	2.6011e-001
Ba-137m	4.6837e+000	1.7330e+011	3.8720e+000	1.4326e+005
Bi-210	1.0956e-010	4.0538e+000	9.0575e-011	3.3513e-006
Bi-211	7.2218e-009	2.6721e+002	5.9702e-009	2.2090e-004
Bi-212	4.2462e-020	1.5711e-009	3.5103e-020	1.2988e-015
Bi-213	8.5035e-006	3.1463e+005	7.0298e-006	2.6010e-001
Bi-214	1.4153e-009	5.2366e+001	1.1700e-009	4.3291e-005
Cm-243	5.0709e-004	1.8762e+007	4.1921e-004	1.5511e+001
Cm-244	4.5353e-004	1.6780e+007	3.7493e-004	1.3872e+001
Co-60	3.4923e-001	1.2922e+010	2.8871e-001	1.0682e+004
Cs-137	4.9510e+000	1.8319e+011	4.0930e+000	1.5144e+005
Eu-154	1.2567e-002	4.6500e+008	1.0389e-002	3.8441e+002
Fr-221	8.5036e-006	3.1463e+005	7.0299e-006	2.6011e-001
Fr-223	1.0254e-010	3.7939e+000	8.4768e-011	3.1364e-006
Np-237	3.2014e-005	1.1845e+006	2.6466e-005	9.7923e-001
Np-239	1.0080e-009	3.7296e+001	8.3331e-010	3.0832e-005
Pa-231	6.3436e-008	2.3471e+003	5.2443e-008	1.9404e-003
Pa-233	3.2013e-005	1.1845e+006	2.6465e-005	9.7922e-001

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK V-9 vessel 320 gal decayed 8yr no shield.ms6
Run Date: August 24, 2004
Run Time: 11:12:37 AM
Duration : 00:00:02

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Pa-234	1.3680e-007	5.0616e+003	1.1309e-007	4.1844e-003
Pa-234m	8.5500e-005	3.1635e+006	7.0683e-005	2.6153e+000
Pb-209	8.5029e-006	3.1461e+005	7.0293e-006	2.6008e-001
Pb-210	1.1036e-010	4.0834e+000	9.1236e-011	3.3757e-006
Pb-211	7.2218e-009	2.6721e+002	5.9702e-009	2.2090e-004
Pb-212	4.2465e-020	1.5712e-009	3.5106e-020	1.2989e-015
Pb-214	1.4153e-009	5.2366e+001	1.1700e-009	4.3291e-005
Po-210	9.0195e-011	3.3372e+000	7.4564e-011	2.7589e-006
Po-211	1.9715e-011	7.2947e-001	1.6299e-011	6.0305e-007
Po-212	2.7205e-020	1.0066e-009	2.2490e-020	8.3214e-016
Po-213	8.3198e-006	3.0783e+005	6.8780e-006	2.5448e-001
Po-214	1.4150e-009	5.2355e+001	1.1698e-009	4.3281e-005
Po-215	7.2220e-009	2.6721e+002	5.9704e-009	2.2090e-004
Po-216	4.2496e-020	1.5724e-009	3.5131e-020	1.2999e-015
Po-218	1.4156e-009	5.2378e+001	1.1703e-009	4.3301e-005
Pu-238	2.0090e-002	7.4331e+008	1.6608e-002	6.1449e+002
Pu-239	7.7483e-003	2.8669e+008	6.4055e-003	2.3700e+002
Pu-240	7.7439e-003	2.8652e+008	6.4019e-003	2.3687e+002
Ra-223	7.2220e-009	2.6721e+002	5.9704e-009	2.2090e-004
Ra-224	4.2496e-020	1.5724e-009	3.5131e-020	1.2999e-015
Ra-225	8.5461e-006	3.1621e+005	7.0650e-006	2.6141e-001
Ra-226	1.4210e-009	5.2576e+001	1.1747e-009	4.3464e-005
Ra-228	9.2991e-020	3.4407e-009	7.6875e-020	2.8444e-015
Rn-219	7.2220e-009	2.6721e+002	5.9704e-009	2.2090e-004
Rn-220	4.2496e-020	1.5724e-009	3.5131e-020	1.2999e-015
Rn-222	1.4156e-009	5.2378e+001	1.1703e-009	4.3301e-005
Sr-90	5.6180e+000	2.0787e+011	4.6444e+000	1.7184e+005
Th-227	7.1989e-009	2.6636e+002	5.9513e-009	2.2020e-004
Th-228	4.2755e-020	1.5819e-009	3.5346e-020	1.3078e-015
Th-229	8.6090e-006	3.1853e+005	7.1170e-006	2.6333e-001
Th-230	8.2095e-007	3.0375e+004	6.7868e-007	2.5111e-002
Th-231	3.7500e-004	1.3875e+007	3.1001e-004	1.1470e+001
Th-232	3.6209e-019	1.3397e-008	2.9934e-019	1.1076e-014
Th-234	8.5500e-005	3.1635e+006	7.0683e-005	2.6153e+000
Tl-207	7.2020e-009	2.6648e+002	5.9539e-009	2.2029e-004
Tl-208	1.5257e-020	5.6449e-010	1.2613e-020	4.6666e-016
Tl-209	1.8367e-007	6.7960e+003	1.5184e-007	5.6182e-003
U-233	1.1400e-002	4.2179e+008	9.4240e-003	3.4869e+002
U-234	1.1400e-002	4.2181e+008	9.4245e-003	3.4871e+002
U-235	3.7500e-004	1.3875e+007	3.1001e-004	1.1470e+001
U-236	1.8346e-009	6.7882e+001	1.5167e-009	5.6118e-005
U-238	8.5500e-005	3.1635e+006	7.0683e-005	2.6153e+000
Y-90	5.6194e+000	2.0792e+011	4.6456e+000	1.7189e+005

Buildup

The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (0,216.5477,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	2.367e-187	1.723e-24	2.030e-188	1.477e-25
0.02	8.777e+00	6.709e-93	1.549e-32	2.324e-94	5.367e-34

ENGINEERING DESIGN FILE

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 DOS File : VTANK V-9 vessel 320 gal decayed 8yr no shield.ms6
 Run Date: August 24, 2004
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 Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.03	1.021e+10	2.380e-26	1.160e-22	2.359e-28	1.150e-24
0.04	2.504e+09	1.034e-11	3.360e-10	4.572e-14	1.486e-12
0.05	2.469e+07	6.557e-08	3.409e-06	1.747e-10	9.081e-09
0.06	7.085e+07	9.493e-05	5.175e-03	1.885e-07	1.028e-05
0.08	2.004e+06	5.307e-04	1.927e-02	8.398e-07	3.049e-05
0.1	2.005e+08	4.270e-01	9.784e+00	6.532e-04	1.497e-02
0.15	2.272e+06	3.258e-02	3.631e-01	5.365e-05	5.980e-04
0.2	4.300e+07	1.319e+00	1.028e+01	2.328e-03	1.815e-02
0.3	3.374e+06	2.318e-01	1.248e+00	4.396e-04	2.367e-03
0.4	3.448e+06	3.926e-01	1.710e+00	7.650e-04	3.332e-03
0.5	1.014e+06	1.686e-01	6.320e-01	3.309e-04	1.241e-03
0.6	1.560e+11	3.515e+04	1.177e+05	6.861e+01	2.298e+02
0.8	1.813e+08	6.579e+01	1.871e+02	1.251e-01	3.558e-01
1.0	1.306e+10	6.845e+03	1.744e+04	1.262e+01	3.215e+01
1.5	1.310e+10	1.328e+04	2.829e+04	2.234e+01	4.759e+01
2.0	1.054e+02	1.680e-04	3.242e-04	2.598e-07	5.013e-07
3.0	5.634e-10	1.659e-15	2.836e-15	2.251e-18	3.848e-18
TOTALS:	1.975e+11	5.534e+04	1.637e+05	1.037e+02	3.100e+02

Results - Dose Point # 2 - (0,244.4877,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	2.247e-187	1.174e-24	1.927e-188	1.007e-25
0.02	8.777e+00	6.552e-93	1.056e-32	2.270e-94	3.659e-34
0.03	1.021e+10	2.351e-26	7.910e-23	2.330e-28	7.839e-25
0.04	2.504e+09	9.832e-12	3.182e-10	4.349e-14	1.407e-12
0.05	2.469e+07	5.633e-08	2.881e-06	1.501e-10	7.675e-09
0.06	7.085e+07	7.429e-05	3.942e-03	1.476e-07	7.830e-06
0.08	2.004e+06	3.740e-04	1.315e-02	5.918e-07	2.081e-05
0.1	2.005e+08	2.879e-01	6.415e+00	4.405e-04	9.815e-03
0.15	2.272e+06	2.123e-02	2.331e-01	3.496e-05	3.839e-04
0.2	4.300e+07	8.516e-01	6.587e+00	1.503e-03	1.163e-02
0.3	3.374e+06	1.489e-01	8.002e-01	2.824e-04	1.518e-03
0.4	3.448e+06	2.519e-01	1.098e+00	4.907e-04	2.140e-03
0.5	1.014e+06	1.081e-01	4.065e-01	2.122e-04	7.979e-04
0.6	1.560e+11	2.254e+04	7.583e+04	4.399e+01	1.480e+02
0.8	1.813e+08	4.220e+01	1.207e+02	8.027e-02	2.297e-01
1.0	1.306e+10	4.395e+03	1.128e+04	8.101e+00	2.079e+01
1.5	1.310e+10	8.545e+03	1.837e+04	1.438e+01	3.091e+01
2.0	1.054e+02	1.084e-04	2.112e-04	1.677e-07	3.267e-07
3.0	5.634e-10	1.076e-15	1.857e-15	1.459e-18	2.520e-18
TOTALS:	1.975e+11	3.552e+04	1.056e+05	6.655e+01	2.000e+02

Results - Dose Point # 3 - (0,274.9677,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	2.123e-187	8.331e-25	1.821e-188	7.146e-26
0.02	8.777e+00	6.394e-93	7.494e-33	2.215e-94	2.596e-34
0.03	1.021e+10	2.293e-26	5.611e-23	2.272e-28	5.561e-25
0.04	2.504e+09	8.736e-12	2.811e-10	3.863e-14	1.243e-12
0.05	2.469e+07	4.498e-08	2.270e-06	1.198e-10	6.046e-09
0.06	7.085e+07	5.536e-05	2.887e-03	1.100e-07	5.733e-06

ENGINEERING DESIGN FILE

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 Run Date: August 24, 2004
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 Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.08	2.004e+06	2.612e-04	9.028e-03	4.133e-07	1.429e-05
0.1	2.005e+08	1.962e-01	4.317e+00	3.002e-04	6.604e-03
0.15	2.272e+06	1.421e-02	1.556e-01	2.340e-05	2.562e-04
0.2	4.300e+07	5.677e-01	4.398e+00	1.002e-03	7.763e-03
0.3	3.374e+06	9.910e-02	5.355e-01	1.880e-04	1.016e-03
0.4	3.448e+06	1.676e-01	7.362e-01	3.266e-04	1.434e-03
0.5	1.014e+06	7.199e-02	2.729e-01	1.413e-04	5.357e-04
0.6	1.560e+11	1.502e+04	5.097e+04	2.932e+01	9.949e+01
0.8	1.813e+08	2.817e+01	8.136e+01	5.357e-02	1.547e-01
1.0	1.306e+10	2.937e+03	7.615e+03	5.414e+00	1.404e+01
1.5	1.310e+10	5.732e+03	1.245e+04	9.643e+00	2.095e+01
2.0	1.054e+02	7.295e-05	1.436e-04	1.128e-07	2.221e-07
3.0	5.634e-10	7.273e-16	1.268e-15	9.867e-19	1.721e-18
TOTALS:	1.975e+11	2.372e+04	7.113e+04	4.443e+01	1.346e+02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	Results - Dose Point # 4 - (0,305.4477,0) cm			
		<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	2.007e-187	6.250e-25	1.722e-188	5.361e-26
0.02	8.777e+00	6.252e-93	5.622e-33	2.166e-94	1.947e-34
0.03	1.021e+10	2.173e-26	4.209e-23	2.153e-28	4.172e-25
0.04	2.504e+09	7.424e-12	2.377e-10	3.283e-14	1.051e-12
0.05	2.469e+07	3.533e-08	1.768e-06	9.413e-11	4.709e-09
0.06	7.085e+07	4.165e-05	2.150e-03	8.274e-08	4.271e-06
0.08	2.004e+06	1.893e-04	6.491e-03	2.996e-07	1.027e-05
0.1	2.005e+08	1.404e-01	3.074e+00	2.148e-04	4.702e-03
0.15	2.272e+06	1.007e-02	1.105e-01	1.659e-05	1.820e-04
0.2	4.300e+07	4.017e-01	3.128e+00	7.091e-04	5.521e-03
0.3	3.374e+06	7.013e-02	3.816e-01	1.330e-04	7.239e-04
0.4	3.448e+06	1.187e-01	5.255e-01	2.313e-04	1.024e-03
0.5	1.014e+06	5.102e-02	1.951e-01	1.001e-04	3.829e-04
0.6	1.560e+11	1.065e+04	3.647e+04	2.080e+01	7.119e+01
0.8	1.813e+08	2.001e+01	5.833e+01	3.806e-02	1.109e-01
1.0	1.306e+10	2.090e+03	5.468e+03	3.852e+00	1.008e+01
1.5	1.310e+10	4.091e+03	8.972e+03	6.884e+00	1.510e+01
2.0	1.054e+02	5.222e-05	1.038e-04	8.075e-08	1.604e-07
3.0	5.634e-10	5.229e-16	9.198e-16	7.094e-19	1.248e-18
TOTALS:	1.975e+11	1.686e+04	5.098e+04	3.157e+01	9.649e+01

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	Results - Dose Point # 5 - (0,335.9277,0) cm			
		<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	1.902e-187	4.834e-25	1.631e-188	4.146e-26
0.02	8.777e+00	6.129e-93	4.348e-33	2.123e-94	1.506e-34
0.03	1.021e+10	1.996e-26	3.255e-23	1.978e-28	3.226e-25
0.04	2.504e+09	6.190e-12	1.975e-10	2.738e-14	8.733e-13
0.05	2.469e+07	2.790e-08	1.388e-06	7.432e-11	3.698e-09
0.06	7.085e+07	3.200e-05	1.642e-03	6.356e-08	3.262e-06
0.08	2.004e+06	1.422e-04	4.856e-03	2.250e-07	7.684e-06
0.1	2.005e+08	1.046e-01	2.288e+00	1.600e-04	3.500e-03
0.15	2.272e+06	7.469e-03	8.227e-02	1.230e-05	1.355e-04
0.2	4.300e+07	2.977e-01	2.332e+00	5.255e-04	4.115e-03

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Run Date: August 24, 2004
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<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>		<u>Exposure Rate</u>	
		<u>MeV/cm²/sec</u>	<u>No Buildup</u> <u>With Buildup</u>	<u>mR/hr</u>	<u>No Buildup</u> <u>With Buildup</u>
0.3	3.374e+06	5.200e-02	2.850e-01	9.863e-05	5.407e-04
0.4	3.448e+06	8.810e-02	3.930e-01	1.717e-04	7.658e-04
0.5	1.014e+06	3.789e-02	1.460e-01	7.438e-05	2.866e-04
0.6	1.560e+11	7.920e+03	2.733e+04	1.546e+01	5.335e+01
0.8	1.813e+08	1.490e+01	4.378e+01	2.833e-02	8.327e-02
1.0	1.306e+10	1.558e+03	4.109e+03	2.872e+00	7.575e+00
1.5	1.310e+10	3.059e+03	6.761e+03	5.146e+00	1.138e+01
2.0	1.054e+02	3.913e-05	7.835e-05	6.051e-08	1.212e-07
3.0	5.634e-10	3.932e-16	6.966e-16	5.335e-19	9.451e-19
TOTALS:	1.975e+11	1.255e+04	3.825e+04	2.351e+01	7.239e+01

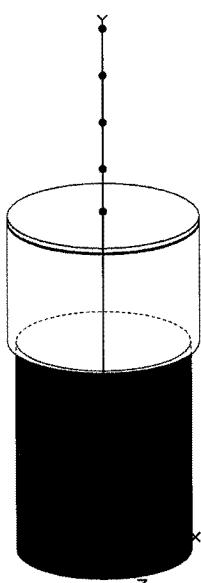
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
 DOS File : VTANK V-9 vessel 320 gal decayed 8yr shield.ms6
 Run Date: August 24, 2004
 Run Time: 11:09:41 AM
 Duration : 00:00:02

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: Vtank 9 Ext Exposure
Description: 320 gal batch decayed 8 yrs w/shield @ cont., 1, 2, 3, 4 ft
Geometry: 8 - Cylinder Volume - End Shields



		Source Dimensions	4 ft 5.3 in
	Height	135.331 cm	1 ft 9.0 in
	Radius	53.34 cm	

Dose Points			
#	<u>X</u>	<u>Y</u>	<u>Z</u>
# 1	0 cm	219.7227 cm	0 cm
	0.0 in	7 ft 2.5 in	0.0 in
# 2	0 cm	247.6627 cm	0 cm
	0.0 in	8 ft 1.5 in	0.0 in
# 3	0 cm	278.1427 cm	0 cm
	0.0 in	9 ft 1.5 in	0.0 in
# 4	0 cm	308.6227 cm	0 cm
	0.0 in	10 ft 1.5 in	0.0 in
# 5	0 cm	339.1027 cm	0 cm
	0.0 in	11 ft 1.5 in	0.0 in

Shields			
<u>Shield Name</u>	<u>Dimension</u>	<u>Material</u>	<u>Density</u>
Source	42.718 ft ³	V123 SLUDGE	1.02
Shield 1	2.55 ft	Air	0.00122
Shield 2	.031 ft	Iron	7.86
Shield 3	.104 ft	Iron	7.86
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices

Number of Groups : 25

Lower Energy Cutoff : 0.015

Photons < 0.015 : Included

Library : Grove

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Ac-225	8.5036e-006	3.1463e+005	7.0299e-006	2.6011e-001
Ac-227	7.4304e-009	2.7492e+002	6.1427e-009	2.2728e-004
Ac-228	9.2959e-020	3.4395e-009	7.6849e-020	2.8434e-015
Am-241	5.2621e-003	1.9470e+008	4.3501e-003	1.6095e+002
Am-243	1.0091e-009	3.7335e+001	8.3419e-010	3.0865e-005
At-217	8.5036e-006	3.1463e+005	7.0299e-006	2.6011e-001
Ba-137m	4.6837e+000	1.7330e+011	3.8720e+000	1.4326e+005
Bi-210	1.0956e-010	4.0538e+000	9.0575e-011	3.3513e-006
Bi-211	7.2218e-009	2.6721e+002	5.9702e-009	2.2090e-004
Bi-212	4.2462e-020	1.5711e-009	3.5103e-020	1.2988e-015
Bi-213	8.5035e-006	3.1463e+005	7.0298e-006	2.6010e-001
Bi-214	1.4153e-009	5.2366e+001	1.1700e-009	4.3291e-005
Cm-243	5.0709e-004	1.8762e+007	4.1921e-004	1.5511e+001
Cm-244	4.5353e-004	1.6780e+007	3.7493e-004	1.3872e+001
Co-60	3.4923e-001	1.2922e+010	2.8871e-001	1.0682e+004
Cs-137	4.9510e+000	1.8319e+011	4.0930e+000	1.5144e+005
Eu-154	1.2567e-002	4.6500e+008	1.0389e-002	3.8441e+002
Fr-221	8.5036e-006	3.1463e+005	7.0299e-006	2.6011e-001
Fr-223	1.0254e-010	3.7939e+000	8.4768e-011	3.1364e-006
Np-237	3.2014e-005	1.1845e+006	2.6466e-005	9.7923e-001
Np-239	1.0080e-009	3.7296e+001	8.3331e-010	3.0832e-005
Pa-231	6.3436e-008	2.3471e+003	5.2443e-008	1.9404e-003

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Run Date: August 24, 2004
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<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Pa-233	3.2013e-005	1.1845e+006	2.6465e-005	9.7922e-001
Pa-234	1.3680e-007	5.0616e+003	1.1309e-007	4.1844e-003
Pa-234m	8.5500e-005	3.1635e+006	7.0683e-005	2.6153e+000
Pb-209	8.5029e-006	3.1461e+005	7.0293e-006	2.6008e-001
Pb-210	1.1036e-010	4.0834e+000	9.1236e-011	3.3757e-006
Pb-211	7.2218e-009	2.6721e+002	5.9702e-009	2.2090e-004
Pb-212	4.2465e-020	1.5712e-009	3.5106e-020	1.2989e-015
Pb-214	1.4153e-009	5.2366e+001	1.1700e-009	4.3291e-005
Po-210	9.0195e-011	3.3372e+000	7.4564e-011	2.7589e-006
Po-211	1.9715e-011	7.2947e-001	1.6299e-011	6.0305e-007
Po-212	2.7205e-020	1.0066e-009	2.2490e-020	8.3214e-016
Po-213	8.3198e-006	3.0783e+005	6.8780e-006	2.5448e-001
Po-214	1.4150e-009	5.2355e+001	1.1698e-009	4.3281e-005
Po-215	7.2220e-009	2.6721e+002	5.9704e-009	2.2090e-004
Po-216	4.2496e-020	1.5724e-009	3.5131e-020	1.2999e-015
Po-218	1.4156e-009	5.2378e+001	1.1703e-009	4.3301e-005
Pu-238	2.0090e-002	7.4331e+008	1.6608e-002	6.1449e+002
Pu-239	7.7483e-003	2.8669e+008	6.4055e-003	2.3700e+002
Pu-240	7.7439e-003	2.8652e+008	6.4019e-003	2.3687e+002
Ra-223	7.2220e-009	2.6721e+002	5.9704e-009	2.2090e-004
Ra-224	4.2496e-020	1.5724e-009	3.5131e-020	1.2999e-015
Ra-225	8.5461e-006	3.1621e+005	7.0650e-006	2.6141e-001
Ra-226	1.4210e-009	5.2576e+001	1.1747e-009	4.3464e-005
Ra-228	9.2991e-020	3.4407e-009	7.6875e-020	2.8444e-015
Rn-219	7.2220e-009	2.6721e+002	5.9704e-009	2.2090e-004
Rn-220	4.2496e-020	1.5724e-009	3.5131e-020	1.2999e-015
Rn-222	1.4156e-009	5.2378e+001	1.1703e-009	4.3301e-005
Sr-90	5.6180e+000	2.0787e+011	4.6444e+000	1.7184e+005
Th-227	7.1989e-009	2.6636e+002	5.9513e-009	2.2020e-004
Th-228	4.2755e-020	1.5819e-009	3.5346e-020	1.3078e-015
Th-229	8.6090e-006	3.1853e+005	7.1170e-006	2.6333e-001
Th-230	8.2095e-007	3.0375e+004	6.7868e-007	2.5111e-002
Th-231	3.7500e-004	1.3875e+007	3.1001e-004	1.1470e+001
Th-232	3.6209e-019	1.3397e-008	2.9934e-019	1.1076e-014
Th-234	8.5500e-005	3.1635e+006	7.0683e-005	2.6153e+000
Tl-207	7.2020e-009	2.6648e+002	5.9539e-009	2.2029e-004
Tl-208	1.5257e-020	5.6449e-010	1.2613e-020	4.6666e-016
Tl-209	1.8367e-007	6.7960e+003	1.5184e-007	5.6182e-003
U-233	1.1400e-002	4.2179e+008	9.4240e-003	3.4869e+002
U-234	1.1400e-002	4.2181e+008	9.4245e-003	3.4871e+002
U-235	3.7500e-004	1.3875e+007	3.1001e-004	1.1470e+001
U-236	1.8346e-009	6.7882e+001	1.5167e-009	5.6118e-005
U-238	8.5500e-005	3.1635e+006	7.0683e-005	2.6153e+000
Y-90	5.6194e+000	2.0792e+011	4.6456e+000	1.7189e+005

Buildup
The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (0,7,20875,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
0.015	2.138e+09	No Buildup 0.000e+00	With Buildup 1.645e-24	No Buildup 0.000e+00	With Buildup 1.411e-25

ENGINEERING DESIGN FILE

Page : 3
DOS File : VTANK V-9 vessel 320 gal decayed 8yr shield.ms6
Run Date: August 24, 2004
Run Time: 11:09:41 AM
Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.02	8.777e+00	0.000e+00	1.480e-32	0.000e+00	5.127e-34
0.03	1.021e+10	6.384e-113	1.108e-22	6.326e-115	1.098e-24
0.04	2.504e+09	5.116e-50	2.431e-22	2.262e-52	1.075e-24
0.05	2.469e+07	1.418e-28	1.591e-23	3.777e-31	4.239e-26
0.06	7.085e+07	1.649e-17	1.013e-14	3.275e-20	2.011e-17
0.08	2.004e+06	2.506e-10	1.032e-07	3.966e-13	1.633e-10
0.1	2.005e+08	4.583e-05	1.050e-02	7.011e-08	1.606e-05
0.15	2.272e+06	2.346e-04	1.752e-02	3.864e-07	2.886e-05
0.2	4.300e+07	3.106e-02	1.249e+00	5.482e-05	2.205e-03
0.3	3.374e+06	1.278e-02	2.639e-01	2.424e-05	5.007e-04
0.4	3.448e+06	3.182e-02	4.446e-01	6.200e-05	8.662e-04
0.5	1.014e+06	1.747e-02	1.851e-01	3.429e-05	3.634e-04
0.6	1.560e+11	4.361e+03	3.745e+04	8.512e+00	7.310e+01
0.8	1.813e+08	1.058e+01	6.708e+01	2.012e-02	1.276e-01
1.0	1.306e+10	1.324e+03	6.766e+03	2.440e+00	1.247e+01
1.5	1.310e+10	3.445e+03	1.255e+04	5.797e+00	2.111e+01
2.0	1.054e+02	5.140e-05	1.552e-04	7.948e-08	2.399e-07
3.0	5.634e-10	6.030e-16	1.465e-15	8.180e-19	1.987e-18
TOTALS:	1.975e+11	9.141e+03	5.683e+04	1.677e+01	1.068e+02

Results - Dose Point # 2 - (0,8.13e+00,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	0.000e+00	1.130e-24	0.000e+00	9.696e-26
0.02	8.777e+00	0.000e+00	1.017e-32	0.000e+00	3.522e-34
0.03	1.021e+10	6.313e-113	7.613e-23	6.257e-115	7.545e-25
0.04	2.504e+09	5.075e-50	1.670e-22	2.245e-52	7.388e-25
0.05	2.469e+07	1.406e-28	1.093e-23	3.745e-31	2.912e-26
0.06	7.085e+07	1.608e-17	9.839e-15	3.195e-20	1.954e-17
0.08	2.004e+06	2.226e-10	8.972e-08	3.523e-13	1.420e-10
0.1	2.005e+08	3.728e-05	8.258e-03	5.703e-08	1.263e-05
0.15	2.272e+06	1.728e-04	1.243e-02	2.845e-07	2.047e-05
0.2	4.300e+07	2.212e-02	8.597e-01	3.905e-05	1.517e-03
0.3	3.374e+06	8.885e-03	1.784e-01	1.685e-05	3.384e-04
0.4	3.448e+06	2.188e-02	2.986e-01	4.264e-05	5.819e-04
0.5	1.014e+06	1.194e-02	1.240e-01	2.343e-05	2.433e-04
0.6	1.560e+11	2.966e+03	2.503e+04	5.790e+00	4.885e+01
0.8	1.813e+08	7.152e+00	4.474e+01	1.360e-02	8.509e-02
1.0	1.306e+10	8.913e+02	4.508e+03	1.643e+00	8.309e+00
1.5	1.310e+10	2.308e+03	8.359e+03	3.883e+00	1.406e+01
2.0	1.054e+02	3.438e-05	1.034e-04	5.316e-08	1.600e-07
3.0	5.634e-10	4.033e-16	9.790e-16	5.472e-19	1.328e-18
TOTALS:	1.975e+11	6.173e+03	3.794e+04	1.133e+01	7.131e+01

Results - Dose Point # 3 - (0,9.13e+00,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	0.000e+00	8.062e-25	0.000e+00	6.915e-26
0.02	8.777e+00	0.000e+00	7.252e-33	0.000e+00	2.512e-34
0.03	1.021e+10	6.237e-113	5.429e-23	6.181e-115	5.381e-25
0.04	2.504e+09	5.029e-50	1.191e-22	2.224e-52	5.269e-25
0.05	2.469e+07	1.374e-28	7.798e-24	3.660e-31	2.077e-26

ENGINEERING DESIGN FILE

Page : 4
DOS File : VTANK V-9 vessel 320 gal decayed 8yr shield.ms6
Run Date: August 24, 2004
Run Time: 11:09:41 AM
Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.06	7.085e+07	1.496e-17	9.079e-15	2.972e-20	1.803e-17
0.08	2.004e+06	1.842e-10	7.282e-08	2.915e-13	1.152e-10
0.1	2.005e+08	2.873e-05	6.218e-03	4.395e-08	9.514e-06
0.15	2.272e+06	1.246e-04	8.779e-03	2.052e-07	1.446e-05
0.2	4.300e+07	1.565e-02	5.975e-01	2.762e-05	1.055e-03
0.3	3.374e+06	6.202e-03	1.229e-01	1.176e-05	2.331e-04
0.4	3.448e+06	1.519e-02	2.052e-01	2.961e-05	3.998e-04
0.5	1.014e+06	8.263e-03	8.510e-02	1.622e-05	1.670e-04
0.6	1.560e+11	2.049e+03	1.717e+04	4.000e+00	3.352e+01
0.8	1.813e+08	4.928e+00	3.070e+01	9.374e-03	5.839e-02
1.0	1.306e+10	6.134e+02	3.095e+03	1.131e+00	5.704e+00
1.5	1.310e+10	1.587e+03	5.748e+03	2.670e+00	9.672e+00
2.0	1.054e+02	2.365e-05	7.127e-05	3.657e-08	1.102e-07
3.0	5.634e-10	2.780e-16	6.768e-16	3.772e-19	9.183e-19
TOTALS:	1.975e+11	4.254e+03	2.605e+04	7.810e+00	4.896e+01

Results - Dose Point # 4 - (0,1.01e+01,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	0.000e+00	6.084e-25	0.000e+00	5.218e-26
0.02	8.777e+00	0.000e+00	5.472e-33	0.000e+00	1.896e-34
0.03	1.021e+10	6.162e-113	4.097e-23	6.107e-115	4.061e-25
0.04	2.504e+09	4.961e-50	8.990e-23	2.194e-52	3.976e-25
0.05	2.469e+07	1.303e-28	5.884e-24	3.472e-31	1.568e-26
0.06	7.085e+07	1.331e-17	8.014e-15	2.644e-20	1.592e-17
0.08	2.004e+06	1.488e-10	5.808e-08	2.355e-13	9.190e-11
0.1	2.005e+08	2.215e-05	4.729e-03	3.388e-08	7.235e-06
0.15	2.272e+06	9.237e-05	6.436e-03	1.521e-07	1.060e-05
0.2	4.300e+07	1.147e-02	4.344e-01	2.025e-05	7.666e-04
0.3	3.374e+06	4.516e-03	8.898e-02	8.566e-06	1.688e-04
0.4	3.448e+06	1.103e-02	1.485e-01	2.150e-05	2.893e-04
0.5	1.014e+06	5.993e-03	6.158e-02	1.176e-05	1.209e-04
0.6	1.560e+11	1.485e+03	1.243e+04	2.899e+00	2.426e+01
0.8	1.813e+08	3.570e+00	2.223e+01	6.790e-03	4.229e-02
1.0	1.306e+10	4.443e+02	2.243e+03	8.189e-01	4.135e+00
1.5	1.310e+10	1.150e+03	4.177e+03	1.935e+00	7.028e+00
2.0	1.054e+02	1.716e-05	5.190e-05	2.654e-08	8.025e-08
3.0	5.634e-10	2.023e-16	4.945e-16	2.745e-19	6.709e-19
TOTALS:	1.975e+11	3.083e+03	1.887e+04	5.660e+00	3.547e+01

Results - Dose Point # 5 - (0,1.11e+01,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	2.138e+09	0.000e+00	4.717e-25	0.000e+00	4.046e-26
0.02	8.777e+00	0.000e+00	4.243e-33	0.000e+00	1.470e-34
0.03	1.021e+10	6.087e-113	3.176e-23	6.032e-115	3.148e-25
0.04	2.504e+09	4.836e-50	6.970e-23	2.139e-52	3.083e-25
0.05	2.469e+07	1.200e-28	4.562e-24	3.196e-31	1.215e-26
0.06	7.085e+07	1.154e-17	6.900e-15	2.292e-20	1.371e-17
0.08	2.004e+06	1.200e-10	4.645e-08	1.900e-13	7.351e-11
0.1	2.005e+08	1.732e-05	3.668e-03	2.650e-08	5.612e-06
0.15	2.272e+06	7.048e-05	4.883e-03	1.161e-07	8.041e-06

ENGINEERING DESIGN FILE

Page : 5
DOS File : VTANK V-9 vessel 320 gal decayed 8yr shield.ms6
Run Date: August 24, 2004
Run Time: 11:09:41 AM
Duration : 00:00:02

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.2	4.300e+07	8.699e-03	3.280e-01	1.535e-05	5.789e-04
0.3	3.374e+06	3.410e-03	6.708e-02	6.469e-06	1.272e-04
0.4	3.448e+06	8.325e-03	1.119e-01	1.622e-05	2.181e-04
0.5	1.014e+06	4.519e-03	4.644e-02	8.871e-06	9.116e-05
0.6	1.560e+11	1.120e+03	9.379e+03	2.186e+00	1.831e+01
0.8	1.813e+08	2.692e+00	1.679e+01	5.120e-03	3.194e-02
1.0	1.306e+10	3.351e+02	1.696e+03	6.177e-01	3.126e+00
1.5	1.310e+10	8.687e+02	3.164e+03	1.462e+00	5.324e+00
2.0	1.054e+02	1.298e-05	3.939e-05	2.007e-08	6.091e-08
3.0	5.634e-10	1.534e-16	3.763e-16	2.082e-19	5.105e-19
TOTALS:	1.975e+11	2.326e+03	1.426e+04	4.270e+00	2.679e+01

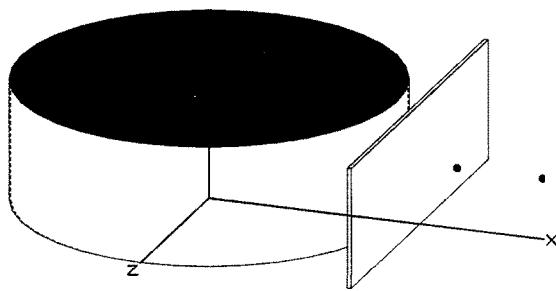
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
 DOS File : VTANK Holding vessel 1880 gal decayed 8yr sens Fe pump shi
 Run Date: August 16, 2004
 Run Time: 9:49:29 AM
 Duration : 00:00:52

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: TAN V tank Process
Description: Waste Decayed 8 yrs 1880 gal 6" gap Fe Shield BU Shield
Geometry: 7 - Cylinder Volume - Side Shields



		Source Dimensions	
		Height	97.5 cm
		Radius	152.4 cm
			3 ft 2.4 in
			5 ft 0.0 in

Dose Points			
# 1	X 202.2475 cm 6 ft 7.6 in	Y 48.8 cm 1 ft 7.2 in	Z 0 cm 0.0 in
# 2	X 271.7675 cm 8 ft 11.0 in	Y 48.8 cm 1 ft 7.2 in	Z 0 cm 0.0 in

Shields				
Shield Name	Dimension	Material	Density	
Source	251.235 ft ³	V123 SLUDGE	1.02	
Shield 1	.031 ft	304L	8	
Transition	.5 ft	Air	0.00122	
Shield 3	.104 ft	Iron	7.86	
Air Gap		Air	0.00122	

Source Input
Grouping Method : Standard Indices

Number of Groups : 25

Lower Energy Cutoff : 0.015

Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Ac-225	2.0513e-005	7.5899e+005	2.8834e-006	1.0669e-001
Ac-227	1.7357e-008	6.4222e+002	2.4398e-009	9.0274e-005
Ac-228	5.1819e-019	1.9173e-008	7.2840e-020	2.6951e-015
Ag-108	4.3623e-004	1.6141e+007	6.1319e-005	2.2688e+000
Ag-108m	4.6907e-003	1.7355e+008	6.5934e-004	2.4396e+001
Ag-110	3.4418e-008	1.2735e+003	4.8380e-009	1.7901e-004
Ag-110m	2.5878e-006	9.5750e+004	3.6376e-007	1.3459e-002
Am-241	5.0843e-002	1.8812e+009	7.1468e-003	2.6443e+002
Am-243	2.1623e-008	8.0004e+002	3.0394e-009	1.1246e-004
At-217	2.0513e-005	7.5898e+005	2.8834e-006	1.0669e-001
Ba-137m	3.5108e+001	1.2990e+012	4.9349e+000	1.8259e+005
Bi-210	2.3232e-003	8.5959e+007	3.2656e-004	1.2083e+001
Bi-211	1.6870e-008	6.2419e+002	2.3713e-009	8.7739e-005
Bi-212	2.3670e-019	8.7578e-009	3.3271e-020	1.2310e-015
Bi-213	2.0513e-005	7.5897e+005	2.8834e-006	1.0668e-001
Bi-214	1.0561e-002	3.9077e+008	1.4845e-003	5.4928e+001
Ce-144	4.7684e-005	1.7643e+006	6.7027e-006	2.4800e-001
Cm-242	8.3558e-010	3.0917e+001	1.1745e-010	4.3458e-006
Cm-243	1.0866e-002	4.0205e+008	1.5274e-003	5.6513e+001
Cm-244	9.7184e-003	3.5958e+008	1.3661e-003	5.0544e+001
Co-58	3.2896e-015	1.2172e-004	4.6241e-016	1.7109e-011
Co-60	7.3339e-001	2.7135e+010	1.0309e-001	3.8143e+003
Cs-134	4.1032e-004	1.5182e+007	5.7676e-005	2.1340e+000
Cs-137	3.7112e+001	1.3731e+012	5.2166e+000	1.9301e+005
Eu-152	7.1172e-002	2.6334e+009	1.0004e-002	3.7016e+002
Eu-154	9.8516e-002	3.6451e+009	1.3848e-002	5.1237e+002
Eu-155	6.7350e-003	2.4919e+008	9.4670e-004	3.5028e+001
Fr-221	2.0513e-005	7.5898e+005	2.8834e-006	1.0669e-001

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK Holding vessel 1880 gal decayed 8yr sens Fe pump shi
Run Date: August 16, 2004
Run Time: 9:49:29 AM
Duration : 00:00:52

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Fr-223	2.3953e-010	8.8626e+000	3.3669e-011	1.2458e-006
Gd-152	1.2315e-015	4.5564e-005	1.7310e-016	6.4046e-012
I-129	3.3700e-004	1.2469e+007	4.7370e-005	1.7527e+000
Mn-54	4.8457e-006	1.7929e+005	6.8114e-007	2.5202e-002
Nb-95	7.1267e-016	2.6369e-005	1.0018e-016	3.7065e-012
Nb-95m	2.7331e-018	1.0112e-007	3.8417e-019	1.4214e-014
Ni-63	5.2131e+000	1.9288e+011	7.3277e-001	2.7113e+004
Np-237	1.6713e-004	6.1839e+006	2.3493e-005	8.6924e-001
Np-239	2.1600e-008	7.9920e+002	3.0362e-009	1.1234e-004
Pa-231	1.4819e-007	5.4829e+003	2.0830e-008	7.7071e-004
Pa-233	1.6713e-004	6.1838e+006	2.3493e-005	8.6923e-001
Pa-234	7.5040e-007	2.7765e+004	1.0548e-007	3.9027e-003
Pa-234m	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000
Pb-209	2.0511e-005	7.5892e+005	2.8832e-006	1.0668e-001
Pb-210	2.3283e-003	8.6146e+007	3.2727e-004	1.2109e+001
Pb-211	1.6870e-008	6.2419e+002	2.3713e-009	8.7739e-005
Pb-212	2.3672e-019	8.7585e-009	3.3274e-020	1.2311e-015
Pb-214	1.0561e-002	3.9077e+008	1.4845e-003	5.4928e+001
Po-210	2.1806e-003	8.0681e+007	3.0651e-004	1.1341e+001
Po-211	4.6055e-011	1.7040e+000	6.4737e-012	2.3953e-007
Po-212	1.5165e-019	5.6111e-009	2.1317e-020	7.8873e-016
Po-213	2.0070e-005	7.4258e+005	2.8211e-006	1.0438e-001
Po-214	1.0559e-002	3.9069e+008	1.4842e-003	5.4917e+001
Po-215	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Po-216	2.3689e-019	8.7649e-009	3.3298e-020	1.2320e-015
Po-218	1.0563e-002	3.9085e+008	1.4848e-003	5.4939e+001
Pr-144	4.7002e-005	1.7391e+006	6.6068e-006	2.4445e-001
Pu-238	8.0453e-002	2.9768e+009	1.1309e-002	4.1843e+002
Pu-239	4.3193e-002	1.5981e+009	6.0714e-003	2.2464e+002
Pu-240	4.3173e-002	1.5974e+009	6.0686e-003	2.2454e+002
Ra-223	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Ra-224	2.3689e-019	8.7650e-009	3.3298e-020	1.2320e-015
Ra-225	2.0616e-005	7.6278e+005	2.8978e-006	1.0722e-001
Ra-226	1.0563e-002	3.9084e+008	1.4848e-003	5.4939e+001
Ra-228	5.1837e-019	1.9180e-008	7.2865e-020	2.6960e-015
Rh-103m	3.3632e-024	1.2444e-013	4.7275e-025	1.7492e-020
Rh-106	2.6177e-004	9.6853e+006	3.6795e-005	1.3614e+000
Rn-219	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Rn-220	2.3689e-019	8.7649e-009	3.3298e-020	1.2320e-015
Rn-222	1.0563e-002	3.9085e+008	1.4848e-003	5.4939e+001
Ru-103	3.3721e-024	1.2477e-013	4.7400e-025	1.7538e-020
Ru-106	2.6177e-004	9.6853e+006	3.6795e-005	1.3614e+000
Sb-125	3.4716e-003	1.2845e+008	4.8799e-004	1.8056e+001
Sr-90	6.8454e+001	2.5328e+012	9.6222e+000	3.5602e+005
Tc-125m	8.5071e-004	3.1476e+007	1.1958e-004	4.4245e+000
Th-227	1.6817e-008	6.2222e+002	2.3638e-009	8.7462e-005
Th-228	2.3833e-019	8.8184e-009	3.3501e-020	1.2396e-015
Th-229	2.0767e-005	7.6839e+005	2.9191e-006	1.0801e-001
Th-230	1.9804e-006	7.3275e+004	2.7837e-007	1.0300e-002
Th-231	8.7600e-004	3.2412e+007	1.2313e-004	4.5560e+000
Th-232	2.0185e-018	7.4684e-008	2.8373e-019	1.0498e-014
Th-234	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000
Tl-207	1.6824e-008	6.2249e+002	2.3648e-009	8.7499e-005
Tl-208	8.5046e-020	3.1467e-009	1.1954e-020	4.4232e-016
Tl-209	4.4308e-007	1.6394e+004	6.2281e-008	2.3044e-003
U-233	2.7499e-002	1.0175e+009	3.8654e-003	1.4302e+002
U-234	2.7501e-002	1.0175e+009	3.8657e-003	1.4303e+002
U-235	8.7600e-004	3.2412e+007	1.2313e-004	4.5560e+000
U-236	1.0228e-008	3.7842e+002	1.4376e-009	5.3192e-005
U-238	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000

ENGINEERING DESIGN FILE

Page : 2
DOS File : VTANK Holding vessel 1880 gal decayed 8yr sens Fe pump shi
Run Date: August 16, 2004
Run Time: 9:49:29 AM
Duration : 00:00:52

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Fr-223	2.3953e-010	8.8626e+000	3.3669e-011	1.2458e-006
Gd-152	1.2315e-015	4.5564e-005	1.7310e-016	6.4046e-012
I-129	3.3700e-004	1.2469e+007	4.7370e-005	1.7527e+000
Mn-54	4.8457e-006	1.7929e+005	6.8114e-007	2.5202e-002
Nb-95	7.1267e-016	2.6369e-005	1.0018e-016	3.7065e-012
Nb-95m	2.7331e-018	1.0112e-007	3.8417e-019	1.4214e-014
Ni-63	5.2131e+000	1.9288e+011	7.3277e-001	2.7113e+004
Np-237	1.6713e-004	6.1839e+006	2.3493e-005	8.6924e-001
Np-239	2.1600e-008	7.9920e+002	3.0362e-009	1.1234e-004
Pa-231	1.4819e-007	5.4829e+003	2.0830e-008	7.7071e-004
Pa-233	1.6713e-004	6.1838e+006	2.3493e-005	8.6923e-001
Pa-234	7.5040e-007	2.7765e+004	1.0548e-007	3.9027e-003
Pa-234m	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000
Pb-209	2.0511e-005	7.5892e+005	2.8832e-006	1.0668e-001
Pb-210	2.3283e-003	8.6146e+007	3.2727e-004	1.2109e+001
Pb-211	1.6870e-008	6.2419e+002	2.3713e-009	8.7739e-005
Pb-212	2.3672e-019	8.7585e-009	3.3274e-020	1.2311e-015
Pb-214	1.0561e-002	3.9077e+008	1.4845e-003	5.4928e+001
Po-210	2.1806e-003	8.0681e+007	3.0651e-004	1.1341e+001
Po-211	4.6055e-011	1.7040e+000	6.4737e-012	2.3953e-007
Po-212	1.5165e-019	5.6111e-009	2.1317e-020	7.8873e-016
Po-213	2.0070e-005	7.4258e+005	2.8211e-006	1.0438e-001
Po-214	1.0559e-002	3.9069e+008	1.4842e-003	5.4917e+001
Po-215	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Po-216	2.3689e-019	8.7649e-009	3.3298e-020	1.2320e-015
Po-218	1.0563e-002	3.9085e+008	1.4848e-003	5.4939e+001
Pr-144	4.7002e-005	1.7391e+006	6.6068e-006	2.4445e-001
Pu-238	8.0453e-002	2.9768e+009	1.1309e-002	4.1843e+002
Pu-239	4.3193e-002	1.5981e+009	6.0714e-003	2.2464e+002
Pu-240	4.3173e-002	1.5974e+009	6.0686e-003	2.2454e+002
Ra-223	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Ra-224	2.3689e-019	8.7650e-009	3.3298e-020	1.2320e-015
Ra-225	2.0616e-005	7.6278e+005	2.8978e-006	1.0722e-001
Ra-226	1.0563e-002	3.9084e+008	1.4848e-003	5.4939e+001
Ra-228	5.1837e-019	1.9180e-008	7.2865e-020	2.6960e-015
Rh-103m	3.3632e-024	1.2444e-013	4.7275e-025	1.7492e-020
Rh-106	2.6177e-004	9.6853e+006	3.6795e-005	1.3614e+000
Rn-219	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Rn-220	2.3689e-019	8.7649e-009	3.3298e-020	1.2320e-015
Rn-222	1.0563e-002	3.9085e+008	1.4848e-003	5.4939e+001
Ru-103	3.3721e-024	1.2477e-013	4.7400e-025	1.7538e-020
Ru-106	2.6177e-004	9.6853e+006	3.6795e-005	1.3614e+000
Sb-125	3.4716e-003	1.2845e+008	4.8799e-004	1.8056e+001
Sr-90	6.8454e+001	2.5328e+012	9.6222e+000	3.5602e+005
Tc-125m	8.5071e-004	3.1476e+007	1.1958e-004	4.4245e+000
Th-227	1.6817e-008	6.2222e+002	2.3638e-009	8.7462e-005
Th-228	2.3833e-019	8.8184e-009	3.3501e-020	1.2396e-015
Th-229	2.0767e-005	7.6839e+005	2.9191e-006	1.0801e-001
Th-230	1.9804e-006	7.3275e+004	2.7837e-007	1.0300e-002
Th-231	8.7600e-004	3.2412e+007	1.2313e-004	4.5560e+000
Th-232	2.0185e-018	7.4684e-008	2.8373e-019	1.0498e-014
Th-234	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000
Tl-207	1.6824e-008	6.2249e+002	2.3648e-009	8.7499e-005
Tl-208	8.5046e-020	3.1467e-009	1.1954e-020	4.4232e-016
Tl-209	4.4308e-007	1.6394e+004	6.2281e-008	2.3044e-003
U-233	2.7499e-002	1.0175e+009	3.8654e-003	1.4302e+002
U-234	2.7501e-002	1.0175e+009	3.8657e-003	1.4303e+002
U-235	8.7600e-004	3.2412e+007	1.2313e-004	4.5560e+000
U-236	1.0228e-008	3.7842e+002	1.4376e-009	5.3192e-005
U-238	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000

ENGINEERING DESIGN FILE

Page : 3
DOS File : VTANK Holding vessel 1880 gal decayed 8yr sens Fe pump shi
Run Date: August 16, 2004
Run Time: 9:49:29 AM
Duration : 00:00:52

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Y-90	6.8454e+001	2.5328e+012	9.6222e+000	3.5602e+005
Zn-65	1.9912e-006	7.3675e+004	2.7989e-007	1.0356e-002
Zr-95	3.2238e-016	1.1928e-005	4.5315e-017	1.6767e-012

Buildup
The material reference is : Shield 3

Integration Parameters		
Radial		21
Circumferential		21
Y Direction (axial)		21

Sensitivity Analysis Summary - X Dose Point 1						
Dose Point #	Sensitivity	Sensitivity Dimension	Fluence Rate MeV/cm ² /sec	Fluence Rate MeV/cm ² /sec	Exposure Rate mR/hr	Exposure Rate mR/hr
		No Buildup	With Buildup	No Buildup	With Buildup	With Buildup
1	(1 of 6)	(6.635 ft)	1.244e+04	6.449e+04	2.351e+01	1.232e+02
1	(2 of 6)	(7.708 ft)	8.644e+03	4.358e+04	1.636e+01	8.328e+01
1	(3 of 6)	(8.781 ft)	6.181e+03	3.082e+04	1.170e+01	5.891e+01
1	(4 of 6)	(9.854 ft)	4.600e+03	2.282e+04	8.708e+00	4.361e+01
1	(5 of 6)	(10.927 ft)	3.544e+03	1.754e+04	6.710e+00	3.352e+01
1	(6 of 6)	(12 ft)	2.810e+03	1.390e+04	5.321e+00	2.656e+01

Results - Dose Point # 1 - (6.64e+00, 1.60e+00, 0 ft)					
Energy MeV	Activity photons/sec	Fluence Rate MeV/cm ² /sec	Fluence Rate MeV/cm ² /sec	Exposure Rate mR/hr	Exposure Rate mR/hr
		No Buildup	With Buildup	No Buildup	With Buildup
0.015	6.230e+04	0.000e+00	2.238e-29	0.000e+00	1.920e-30
0.02	1.141e+08	0.000e+00	6.442e-26	0.000e+00	2.231e-27
0.03	7.667e+10	7.470e-113	5.945e-23	7.403e-115	5.892e-25
0.04	2.041e+10	6.495e-50	2.420e-23	2.873e-52	1.070e-25
0.05	6.026e+08	4.954e-28	1.022e-24	1.320e-30	2.722e-27
0.06	6.855e+08	2.332e-17	3.859e-17	4.633e-20	7.666e-20
0.08	1.851e+08	3.645e-09	8.074e-09	5.768e-12	1.278e-11
0.1	2.481e+09	9.730e-05	2.783e-04	1.489e-07	4.258e-07
0.15	7.083e+06	1.505e-04	6.549e-04	2.478e-07	1.078e-06
0.2	5.741e+08	9.365e-02	5.356e-01	1.653e-04	9.454e-04
0.3	8.558e+08	8.000e-01	5.329e+00	1.518e-03	1.011e-02
0.4	5.377e+08	1.287e+00	8.540e+00	2.508e-03	1.664e-02
0.5	4.533e+07	2.098e-01	1.305e+00	4.119e-04	2.562e-03
0.6	1.170e+12	9.040e+03	5.202e+04	1.764e+01	1.015e+02
0.8	2.099e+09	3.538e+01	1.748e+02	6.730e-02	3.325e-01
1.0	2.951e+10	8.944e+02	3.874e+03	1.649e+00	7.141e+00
1.5	2.924e+10	2.448e+03	8.341e+03	4.119e+00	1.403e+01
2.0	1.046e+08	1.692e+01	5.005e+01	2.616e-02	7.740e-02
3.0	3.140e-09	1.173e-15	2.896e-15	1.592e-18	3.930e-18
TOTALS:	1.334e+12	1.244e+04	6.448e+04	2.351e+01	1.232e+02
	Sensitivity	Variable	X Dose Point 1	(1 of 6)	(6.635 ft)
0.015	6.230e+04	0.000e+00	2.239e-29	0.000e+00	1.920e-30
0.02	1.141e+08	0.000e+00	6.443e-26	0.000e+00	2.232e-27
0.03	7.667e+10	7.470e-113	5.946e-23	7.403e-115	5.893e-25
0.04	2.041e+10	6.496e-50	2.420e-23	2.873e-52	1.070e-25
0.05	6.026e+08	4.954e-28	1.022e-24	1.320e-30	2.722e-27
0.06	6.855e+08	2.332e-17	3.859e-17	4.633e-20	7.666e-20
0.08	1.851e+08	3.645e-09	8.074e-09	5.768e-12	1.278e-11
0.1	2.481e+09	9.730e-05	2.783e-04	1.489e-07	4.258e-07

ENGINEERING DESIGN FILE

Page : 4
 DOS File : VTANK Holding vessel 1880 gal decayed 8yr sens Fe pump shi
 Run Date: August 16, 2004
 Run Time: 9:49:29 AM
 Duration : 00:00:52

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.15	7.083e+06	1.505e-04	6.550e-04	2.478e-07	1.079e-06
0.2	5.741e+08	9.366e-02	5.357e-01	1.653e-04	9.454e-04
0.3	8.558e+08	8.001e-01	5.330e+00	1.518e-03	1.011e-02
0.4	5.377e+08	1.287e+00	8.542e+00	2.508e-03	1.664e-02
0.5	4.533e+07	2.099e-01	1.306e+00	4.119e-04	2.563e-03
0.6	1.170e+12	9.041e+03	5.203e+04	1.765e+01	1.016e+02
0.8	2.099e+09	3.539e+01	1.749e+02	6.731e-02	3.326e-01
1.0	2.951e+10	8.945e+02	3.875e+03	1.649e+00	7.142e+00
1.5	2.924e+10	2.448e+03	8.342e+03	4.119e+00	1.404e+01
2.0	1.046e+08	1.692e+01	5.006e+01	2.616e-02	7.741e-02
3.0	3.140e-09	1.174e-15	2.897e-15	1.592e-18	3.930e-18
TOTALS:	1.334e+12	1.244e+04	6.449e+04	2.351e+01	1.232e+02
	Sensitivity	Variable	X Dose Point 1	(2 of 6)	(7.708 ft)
0.015	6.230e+04	0.000e+00	1.500e-29	0.000e+00	1.286e-30
0.02	1.141e+08	0.000e+00	4.316e-26	0.000e+00	1.495e-27
0.03	7.667e+10	6.152e-113	3.983e-23	6.097e-115	3.947e-25
0.04	2.041e+10	5.307e-50	1.621e-23	2.347e-52	7.171e-26
0.05	6.026e+08	4.700e-28	6.845e-25	1.252e-30	1.823e-27
0.06	6.855e+08	2.242e-17	3.709e-17	4.453e-20	7.367e-20
0.08	1.851e+08	3.321e-09	7.349e-09	5.255e-12	1.163e-11
0.1	2.481e+09	8.481e-05	2.419e-04	1.298e-07	3.700e-07
0.15	7.083e+06	1.200e-04	5.154e-04	1.976e-07	8.487e-07
0.2	5.741e+08	7.147e-02	3.998e-01	1.261e-04	7.056e-04
0.3	8.558e+08	5.871e-01	3.793e+00	1.114e-03	7.196e-03
0.4	5.377e+08	9.256e-01	5.940e+00	1.804e-03	1.157e-02
0.5	4.533e+07	1.489e-01	8.954e-01	2.922e-04	1.758e-03
0.6	1.170e+12	6.348e+03	3.535e+04	1.239e+01	6.899e+01
0.8	2.099e+09	2.448e+01	1.173e+02	4.656e-02	2.231e-01
1.0	2.951e+10	6.120e+02	2.579e+03	1.128e+00	4.754e+00
1.5	2.924e+10	1.647e+03	5.490e+03	2.770e+00	9.236e+00
2.0	1.046e+08	1.128e+01	3.277e+01	1.744e-02	5.068e-02
3.0	3.140e-09	7.757e-16	1.891e-15	1.052e-18	2.565e-18
TOTALS:	1.334e+12	8.644e+03	4.358e+04	1.636e+01	8.328e+01
	Sensitivity	Variable	X Dose Point 1	(3 of 6)	(8.781 ft)
0.015	6.230e+04	0.000e+00	1.089e-29	0.000e+00	9.337e-31
0.02	1.141e+08	0.000e+00	3.133e-26	0.000e+00	1.085e-27
0.03	7.667e+10	5.130e-113	2.891e-23	5.085e-115	2.866e-25
0.04	2.041e+10	5.069e-50	1.177e-23	2.242e-52	5.205e-26
0.05	6.026e+08	4.432e-28	4.969e-25	1.181e-30	1.324e-27
0.06	6.855e+08	2.054e-17	3.397e-17	4.079e-20	6.748e-20
0.08	1.851e+08	2.882e-09	6.371e-09	4.561e-12	1.008e-11
0.1	2.481e+09	6.962e-05	1.979e-04	1.065e-07	3.028e-07
0.15	7.083e+06	9.180e-05	3.912e-04	1.512e-07	6.443e-07
0.2	5.741e+08	5.331e-02	2.948e-01	9.409e-05	5.203e-04
0.3	8.558e+08	4.294e-01	2.737e+00	8.145e-04	5.192e-03
0.4	5.377e+08	6.709e-01	4.246e+00	1.307e-03	8.272e-03
0.5	4.533e+07	1.073e-01	6.366e-01	2.106e-04	1.250e-03
0.6	1.170e+12	4.556e+03	2.504e+04	8.893e+00	4.888e+01
0.8	2.099e+09	1.746e+01	8.274e+01	3.322e-02	1.574e-01
1.0	2.951e+10	4.349e+02	1.814e+03	8.016e-01	3.344e+00
1.5	2.924e+10	1.163e+03	3.849e+03	1.957e+00	6.476e+00
2.0	1.046e+08	7.941e+00	2.296e+01	1.228e-02	3.550e-02

ENGINEERING DESIGN FILE

Page : 5
 DOS File : VTANK Holding vessel 1880 gal decayed 8yr sens Fe pump shi
 Run Date: August 16, 2004
 Run Time: 9:49:29 AM
 Duration : 00:00:52

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>No Buildup</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>No Buildup</u> <u>With Buildup</u>	<u>Exposure Rate</u> <u>mR/hr</u> <u>With Buildup</u>
3.0	3.140e-09	5.454e-16	1.325e-15	7.399e-19	1.798e-18
TOTALS:	1.334e+12	6.181e+03	3.082e+04	1.170e+01	5.891e+01
	Sensitivity	Variable	X Dose Point 1	(4 of 6)	(9.854 ft)
0.015	6.230e+04	0.000e+00	8.317e-30	0.000e+00	7.134e-31
0.02	1.141e+08	0.000e+00	2.394e-26	0.000e+00	8.291e-28
0.03	7.667e+10	4.681e-113	2.209e-23	4.639e-115	2.189e-25
0.04	2.041e+10	4.804e-50	8.992e-24	2.125e-52	3.977e-26
0.05	6.026e+08	4.071e-28	3.796e-25	1.085e-30	1.011e-27
0.06	6.855e+08	1.839e-17	3.042e-17	3.653e-20	6.042e-20
0.08	1.851e+08	2.420e-09	5.345e-09	3.830e-12	8.458e-12
0.1	2.481e+09	5.605e-05	1.590e-04	8.576e-08	2.433e-07
0.15	7.083e+06	7.079e-05	3.004e-04	1.166e-07	4.947e-07
0.2	5.741e+08	4.054e-02	2.229e-01	7.155e-05	3.934e-04
0.3	8.558e+08	3.232e-01	2.046e+00	6.131e-04	3.882e-03
0.4	5.377e+08	5.027e-01	3.159e+00	9.794e-04	6.155e-03
0.5	4.533e+07	8.016e-02	4.724e-01	1.573e-04	9.272e-04
0.6	1.170e+12	3.397e+03	1.855e+04	6.630e+00	3.621e+01
0.8	2.099e+09	1.298e+01	6.118e+01	2.469e-02	1.164e-01
1.0	2.951e+10	3.226e+02	1.340e+03	5.947e-01	2.470e+00
1.5	2.924e+10	8.606e+02	2.841e+03	1.448e+00	4.779e+00
2.0	1.046e+08	5.871e+00	1.695e+01	9.080e-03	2.621e-02
3.0	3.140e-09	4.033e-16	9.800e-16	5.472e-19	1.330e-18
TOTALS:	1.334e+12	4.600e+03	2.282e+04	8.708e+00	4.361e+01
	Sensitivity	Variable	X Dose Point 1	(5 of 6)	(10.927 ft)
0.015	6.230e+04	0.000e+00	6.587e-30	0.000e+00	5.650e-31
0.02	1.141e+08	0.000e+00	1.896e-26	0.000e+00	6.566e-28
0.03	7.667e+10	4.413e-113	1.749e-23	4.373e-115	1.734e-25
0.04	2.041e+10	4.471e-50	7.121e-24	1.977e-52	3.150e-26
0.05	6.026e+08	3.689e-28	3.007e-25	9.826e-31	8.009e-28
0.06	6.855e+08	1.614e-17	2.668e-17	3.205e-20	5.300e-20
0.08	1.851e+08	2.012e-09	4.440e-09	3.184e-12	7.027e-12
0.1	2.481e+09	4.529e-05	1.283e-04	6.929e-08	1.963e-07
0.15	7.083e+06	5.569e-05	2.358e-04	9.170e-08	3.883e-07
0.2	5.741e+08	3.162e-02	1.733e-01	5.581e-05	3.059e-04
0.3	8.558e+08	2.505e-01	1.580e+00	4.752e-04	2.998e-03
0.4	5.377e+08	3.886e-01	2.433e+00	7.572e-04	4.740e-03
0.5	4.533e+07	6.187e-02	3.634e-01	1.214e-04	7.132e-04
0.6	1.170e+12	2.619e+03	1.426e+04	5.112e+00	2.783e+01
0.8	2.099e+09	9.995e+00	4.700e+01	1.901e-02	8.939e-02
1.0	2.951e+10	2.482e+02	1.029e+03	4.575e-01	1.897e+00
1.5	2.924e+10	6.616e+02	2.183e+03	1.113e+00	3.673e+00
2.0	1.046e+08	4.514e+00	1.304e+01	6.981e-03	2.016e-02
3.0	3.140e-09	3.104e-16	7.551e-16	4.211e-19	1.024e-18
TOTALS:	1.334e+12	3.544e+03	1.754e+04	6.710e+00	3.352e+01
	Sensitivity	Variable	X Dose Point 1	(6 of 6)	(12 ft)
0.015	6.230e+04	0.000e+00	5.358e-30	0.000e+00	4.596e-31
0.02	1.141e+08	0.000e+00	1.542e-26	0.000e+00	5.341e-28
0.03	7.667e+10	4.169e-113	1.423e-23	4.132e-115	1.410e-25
0.04	2.041e+10	4.117e-50	5.793e-24	1.821e-52	2.562e-26
0.05	6.026e+08	3.302e-28	2.446e-25	8.795e-31	6.515e-28

ENGINEERING DESIGN FILE

Page : 6
 DOS File : VTANK Holding vessel 1880 gal decayed 8yr sens Fe pump shi
 Run Date: August 16, 2004
 Run Time: 9:49:29 AM
 Duration : 00:00:52

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.06	6.855e+08	1.400e-17	2.314e-17	2.780e-20	4.596e-20
0.08	1.851e+08	1.677e-09	3.698e-09	2.653e-12	5.852e-12
0.1	2.481e+09	3.701e-05	1.048e-04	5.662e-08	1.603e-07
0.15	7.083e+06	4.471e-05	1.890e-04	7.363e-08	3.113e-07
0.2	5.741e+08	2.525e-02	1.381e-01	4.456e-05	2.438e-04
0.3	8.558e+08	1.993e-01	1.254e+00	3.780e-04	2.379e-03
0.4	5.377e+08	3.086e-01	1.929e+00	6.013e-04	3.758e-03
0.5	4.533e+07	4.909e-02	2.879e-01	9.636e-05	5.652e-04
0.6	1.170e+12	2.077e+03	1.130e+04	4.054e+00	2.205e+01
0.8	2.099e+09	7.923e+00	3.724e+01	1.507e-02	7.083e-02
1.0	2.951e+10	1.967e+02	8.158e+02	3.626e-01	1.504e+00
1.5	2.924e+10	5.244e+02	1.732e+03	8.823e-01	2.913e+00
2.0	1.046e+08	3.580e+00	1.035e+01	5.536e-03	1.600e-02
3.0	3.140e-09	2.464e-16	6.004e-16	3.344e-19	8.146e-19
TOTALS:	1.334e+12	2.810e+03	1.390e+04	5.321e+00	2.656e+01

Results - Dose Point # 2 - (8.92e+00,1.60e+00,0) ft

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	6.230e+04	0.000e+00	1.050e-29	0.000e+00	9.004e-31
0.02	1.141e+08	0.000e+00	3.021e-26	0.000e+00	1.046e-27
0.03	7.667e+10	5.052e-113	2.788e-23	5.007e-115	2.763e-25
0.04	2.041e+10	5.041e-50	1.135e-23	2.230e-52	5.020e-26
0.05	6.026e+08	4.388e-28	4.792e-25	1.169e-30	1.276e-27
0.06	6.855e+08	2.028e-17	3.355e-17	4.028e-20	6.663e-20
0.08	1.851e+08	2.823e-09	6.239e-09	4.467e-12	9.874e-12
0.1	2.481e+09	6.777e-05	1.926e-04	1.037e-07	2.946e-07
0.15	7.083e+06	8.876e-05	3.780e-04	1.462e-07	6.225e-07
0.2	5.741e+08	5.143e-02	2.841e-01	9.077e-05	5.015e-04
0.3	8.558e+08	4.136e-01	2.633e+00	7.845e-04	4.995e-03
0.4	5.377e+08	6.457e-01	4.082e+00	1.258e-03	7.953e-03
0.5	4.533e+07	1.032e-01	6.117e-01	2.026e-04	1.201e-03
0.6	1.170e+12	4.381e+03	2.406e+04	8.552e+00	4.696e+01
0.8	2.099e+09	1.679e+01	7.946e+01	3.193e-02	1.511e-01
1.0	2.951e+10	4.179e+02	1.742e+03	7.702e-01	3.211e+00
1.5	2.924e+10	1.117e+03	3.695e+03	1.879e+00	6.216e+00
2.0	1.046e+08	7.626e+00	2.204e+01	1.179e-02	3.408e-02
3.0	3.140e-09	5.237e-16	1.272e-15	7.105e-19	1.726e-18
TOTALS:	1.334e+12	5.942e+03	2.960e+04	1.125e+01	5.658e+01

ENGINEERING DESIGN FILE

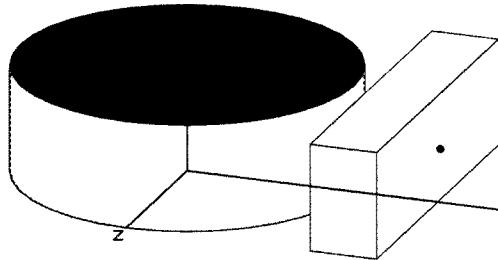
MicroShield v6.02 (6.02-00061) INEEL

Page : 1

DOS File : VTANK Holding vessel 1880 gal decayed 8yr concrete shield.
Run Date: July 27, 2004
Run Time: 7:09:24 PM
Duration : 00:00:13

File Ref: _____
Date: _____
By: _____
Checked: _____

Case Title: TAN V tank Process
Description: V-tank Decayed 8 yrs 1880 gal 6" air gap sens @ 3' steps
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions			
Height	97.5 cm	3 ft 2.4 in	
Radius	152.4 cm	5 ft 0.0 in	
Dose Points			
# 1	X 2.32e+02 cm 7 ft 7.4 in	Y 48.8 cm 1 ft 7.2 in	Z 0 cm 0.0 in
# 2	3.21e+02 cm 10 ft 6.4 in	48.8 cm 1 ft 7.2 in	0 cm 0.0 in
Shields			
Shield Name	Dimension	Material	Density
Source	4.34e+05 in ³	V123 SLUDGE	1.02
Shield 1	.375 in	304L	8
Transition	6.0 in	Air	0.00122
Shield 3	24.0 in	Concrete	2.35
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm ³
Ac-225	2.0513e-005	7.5899e+005	2.8834e-006	1.0669e-001
Ac-227	1.7357e-008	6.4222e+002	2.4398e-009	9.0274e-005
Ac-228	5.1819e-019	1.9173e-008	7.2840e-020	2.6951e-015
Ag-108	4.3623e-004	1.6141e+007	6.1319e-005	2.2688e+000
Ag-108m	4.6907e-003	1.7355e+008	6.5934e-004	2.4396e+001
Ag-110	3.4418e-008	1.2735e+003	4.8380e-009	1.7901e-004
Ag-110m	2.5878e-006	9.5750e+004	3.6376e-007	1.3459e-002
Am-241	5.0843e-002	1.8812e+009	7.1468e-003	2.6443e+002
Am-243	2.1623e-008	8.0004e+002	3.0394e-009	1.1246e-004
At-217	2.0513e-005	7.5898e+005	2.8834e-006	1.0669e-001
Ba-137m	3.5108e+001	1.2990e+012	4.9349e+000	1.8259e+005
Bi-210	2.3232e-003	8.5959e+007	3.2656e-004	1.2083e+001
Bi-211	1.6870e-008	6.2419e+002	2.3713e-009	8.7739e-005
Bi-212	2.3670e-019	8.7578e-009	3.3271e-020	1.2310e-015
Bi-213	2.0513e-005	7.5897e+005	2.8834e-006	1.0668e-001
Bi-214	1.0561e-002	3.9077e+008	1.4845e-003	5.4928e+001
Ce-144	4.7684e-005	1.7643e+006	6.7027e-006	2.4800e-001
Cm-242	8.3558e-010	3.0917e+001	1.1745e-010	4.3458e-006
Cm-243	1.0866e-002	4.0205e+008	1.5274e-003	5.6513e+001
Cm-244	9.7184e-003	3.5958e+008	1.3661e-003	5.0544e+001
Co-58	3.2896e-015	1.2172e-004	4.6241e-016	1.7109e-011
Co-60	7.3339e-001	2.7135e+010	1.0309e-001	3.8143e+003
Cs-134	4.1032e-004	1.5182e+007	5.7676e-005	2.1340e+000
Cs-137	3.7112e+001	1.3731e+012	5.2166e+000	1.9301e+005
Eu-152	7.1172e-002	2.6334e+009	1.0004e-002	3.7016e+002
Eu-154	9.8516e-002	3.6451e+009	1.3848e-002	5.1237e+002
Eu-155	6.7350e-003	2.4919e+008	9.4670e-004	3.5028e+001
Fr-221	2.0513e-005	7.5898e+005	2.8834e-006	1.0669e-001

ENGINEERING DESIGN FILE

Page : 2
 DOS File : VTANK Holding vessel 1880 gal decayed 8yr concrete shield.
 Run Date: July 27, 2004
 Run Time: 7:09:24 PM
 Duration : 00:00:13

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Fr-223	2.3953e-010	8.8626e+000	3.3669e-011	1.2458e-006
Gd-152	1.2315e-015	4.5564e-005	1.7310e-016	6.4046e-012
I-129	3.3700e-004	1.2469e+007	4.7370e-005	1.7527e+000
Mn-54	4.8457e-006	1.7929e+005	6.8114e-007	2.5202e-002
Nb-95	7.1267e-016	2.6369e-005	1.0018e-016	3.7065e-012
Nb-95m	2.7331e-018	1.0112e-007	3.8417e-019	1.4214e-014
Ni-63	5.2131e+000	1.9288e+011	7.3277e-001	2.7113e+004
Np-237	1.6713e-004	6.1839e+006	2.3493e-005	8.6924e-001
Np-239	2.1600e-008	7.9920e+002	3.0362e-009	1.1234e-004
Pa-231	1.4819e-007	5.4829e+003	2.0830e-008	7.7071e-004
Pa-233	1.6713e-004	6.1838e+006	2.3493e-005	8.6923e-001
Pa-234	7.5040e-007	2.7765e+004	1.0548e-007	3.9027e-003
Pa-234m	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000
Pb-209	2.0511e-005	7.5892e+005	2.8832e-006	1.0668e-001
Pb-210	2.3283e-003	8.6146e+007	3.2727e-004	1.2109e+001
Pb-211	1.6870e-008	6.2419e+002	2.3713e-009	8.7739e-005
Pb-212	2.3672e-019	8.7585e-009	3.3274e-020	1.2311e-015
Pb-214	1.0561e-002	3.9077e+008	1.4845e-003	5.4928e+001
Po-210	2.1806e-003	8.0681e+007	3.0651e-004	1.1341e+001
Po-211	4.6055e-011	1.7040e+000	6.4737e-012	2.3953e-007
Po-212	1.5165e-019	5.6111e-009	2.1317e-020	7.8873e-016
Po-213	2.0070e-005	7.4258e+005	2.8211e-006	1.0438e-001
Po-214	1.0559e-002	3.9069e+008	1.4842e-003	5.4917e+001
Po-215	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Po-216	2.3689e-019	8.7649e-009	3.3298e-020	1.2320e-015
Po-218	1.0563e-002	3.9085e+008	1.4848e-003	5.4939e+001
Pr-144	4.7002e-005	1.7391e+006	6.6068e-006	2.4445e-001
Pu-238	8.0453e-002	2.9768e+009	1.1309e-002	4.1843e+002
Pu-239	4.3193e-002	1.5981e+009	6.0714e-003	2.2464e+002
Pu-240	4.3173e-002	1.5974e+009	6.0686e-003	2.2454e+002
Ra-223	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Ra-224	2.3689e-019	8.7650e-009	3.3298e-020	1.2320e-015
Ra-225	2.0616e-005	7.6278e+005	2.8978e-006	1.0722e-001
Ra-226	1.0563e-002	3.9084e+008	1.4848e-003	5.4939e+001
Ra-228	5.1837e-019	1.9180e-008	7.2865e-020	2.6960e-015
Rh-103m	3.3666e-024	1.2456e-013	4.7322e-025	1.7509e-020
Rh-106	2.6177e-004	9.6853e+006	3.6795e-005	1.3614e+000
Rn-219	1.6871e-008	6.2421e+002	2.3714e-009	8.7742e-005
Rn-220	2.3689e-019	8.7649e-009	3.3298e-020	1.2320e-015
Rn-222	1.0563e-002	3.9085e+008	1.4848e-003	5.4939e+001
Ru-103	3.3721e-024	1.2477e-013	4.7400e-025	1.7538e-020
Ru-106	2.6177e-004	9.6853e+006	3.6795e-005	1.3614e+000
Sb-125	3.4716e-003	1.2845e+008	4.8799e-004	1.8056e+001
Sr-90	6.8454e+001	2.5328e+012	9.6222e+000	3.5602e+005
Te-125m	8.5071e-004	3.1476e+007	1.1958e-004	4.4245e+000
Th-227	1.6817e-008	6.2222e+002	2.3638e-009	8.7462e-005
Th-228	2.3833e-019	8.8184e-009	3.3501e-020	1.2396e-015
Th-229	2.0767e-005	7.6839e+005	2.9191e-006	1.0801e-001
Th-230	1.9804e-006	7.3275e+004	2.7837e-007	1.0300e-002
Th-231	8.7600e-004	3.2412e+007	1.2313e-004	4.5560e+000
Th-232	2.0185e-018	7.4684e-008	2.8373e-019	1.0498e-014
Th-234	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000
Tl-207	1.6824e-008	6.2249e+002	2.3648e-009	8.7499e-005
Tl-208	8.5046e-020	3.1467e-009	1.1954e-020	4.4232e-016
Tl-209	4.4308e-007	1.6394e+004	6.2281e-008	2.3044e-003
U-233	2.7499e-002	1.0175e+009	3.8654e-003	1.4302e+002
U-234	2.7501e-002	1.0175e+009	3.8657e-003	1.4303e+002
U-235	8.7600e-004	3.2412e+007	1.2313e-004	4.5560e+000
U-236	1.0228e-008	3.7842e+002	1.4376e-009	5.3192e-005
U-238	4.6900e-004	1.7353e+007	6.5925e-005	2.4392e+000

ENGINEERING DESIGN FILE

Page : 3
 DOS File : VTANK Holding vessel 1880 gal decayed 8yr concrete shield.
 Run Date: July 27, 2004
 Run Time: 7:09:24 PM
 Duration : 00:00:13

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm^3
Y-90	6.8454e+001	2.5328e+012	9.6222e+000	3.5602e+005
Zn-65	1.9912e-006	7.3675e+004	2.7989e-007	1.0356e-002
Zr-95	3.2238e-016	1.1928e-005	4.5315e-017	1.6767e-012

Buildup
The material reference is : Source

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (91.37496,1.92e+01,0) in

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec	With Buildup	No Buildup	With Buildup
0.015	6.230e+004	0.000e+000	2.287e-29	0.000e+000	1.962e-30
0.02	1.141e+008	8.094e-306	9.177e-26	2.804e-307	3.179e-27
0.03	7.667e+10	5.578e-98	3.968e-22	5.528e-100	3.932e-24
0.04	2.041e+10	1.232e-47	9.457e-22	5.451e-50	4.182e-24
0.05	6.026e+008	1.081e-30	1.853e-22	2.880e-33	4.937e-25
0.06	6.855e+008	2.723e-22	2.931e-19	5.408e-25	5.822e-22
0.08	1.851e+008	6.999e-16	1.130e-12	1.108e-18	1.788e-15
0.1	2.481e+009	6.011e-12	1.069e-08	9.196e-15	1.635e-11
0.15	7.083e+006	1.064e-11	1.358e-08	1.752e-14	2.236e-11
0.2	5.741e+008	1.695e-08	1.326e-05	2.991e-11	2.340e-08
0.3	8.558e+008	8.164e-07	2.773e-04	1.549e-09	5.259e-07
0.4	5.377e+008	4.853e-06	8.714e-04	9.456e-09	1.698e-06
0.5	4.533e+007	2.162e-06	2.379e-04	4.244e-09	4.670e-07
0.6	1.170e+12	2.071e-01	1.567e+01	4.042e-04	3.059e-02
0.8	2.099e+009	2.722e-03	1.163e-01	5.177e-06	2.212e-04
1.0	2.951e+10	1.676e-01	4.749e+00	3.089e-04	8.753e-03
1.5	2.924e+10	2.026e+00	2.971e+01	3.409e-03	4.998e-02
2.0	1.046e+008	3.514e-02	3.476e-01	5.434e-05	5.375e-04
3.0	3.140e-009	7.254e-18	4.544e-17	9.842e-21	6.165e-20
TOTALS:	1.334e+12	2.439e+00	5.060e+01	4.181e-03	9.009e-02

Results - Dose Point # 2 - (126.3756,1.92e+01,0) in

Energy MeV	Activity photons/sec	Fluence Rate	Fluence Rate	Exposure Rate	Exposure Rate
		MeV/cm ² /sec	With Buildup	No Buildup	With Buildup
0.015	6.230e+004	0.000e+000	1.058e-29	0.000e+000	9.071e-31
0.02	1.141e+008	5.582e-306	4.244e-26	1.933e-307	1.470e-27
0.03	7.667e+10	4.060e-98	1.835e-22	4.023e-100	1.818e-24
0.04	2.041e+10	1.055e-47	4.373e-22	4.664e-50	1.934e-24
0.05	6.026e+008	8.977e-31	8.569e-23	2.391e-33	2.283e-25
0.06	6.855e+008	2.189e-22	2.340e-19	4.349e-25	4.648e-22
0.08	1.851e+008	5.435e-16	8.651e-13	8.601e-19	1.369e-15
0.1	2.481e+009	4.566e-12	7.935e-09	6.985e-15	1.214e-11
0.15	7.083e+006	7.806e-12	9.623e-09	1.285e-14	1.585e-11
0.2	5.741e+008	1.212e-08	9.122e-06	2.139e-11	1.610e-08
0.3	8.558e+008	5.607e-07	1.829e-04	1.064e-09	3.470e-07
0.4	5.377e+008	3.230e-06	5.571e-04	6.293e-09	1.085e-06
0.5	4.533e+007	1.402e-06	1.483e-04	2.751e-09	2.912e-07
0.6	1.170e+12	1.313e-01	9.567e+00	2.563e-04	1.867e-02
0.8	2.099e+009	1.665e-03	6.862e-02	3.167e-06	1.305e-04
1.0	2.951e+10	9.966e-02	2.728e+00	1.837e-04	5.028e-03

ENGINEERING DESIGN FILE

Page : 4
DOS File : VTANK Holding vessel 1880 gal decayed 8yr concrete shield.
Run Date: July 27, 2004
Run Time: 7:09:24 PM
Duration : 00:00:13

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>		<u>Exposure Rate</u>	
		<u>MeV/cm²/sec</u>	<u>No Buildup</u> <u>With Buildup</u>	<u>mR/hr</u>	<u>With Buildup</u>
1.5	2.924e+10	1.145e+00	1.628e+01	1.926e-03	2.739e-02
2.0	1.046e+08	1.921e-02	1.847e-01	2.971e-05	2.857e-04
3.0	3.140e-09	3.808e-18	2.328e-17	5.167e-21	3.159e-20
TOTALS:	1.334e+12	1.397e+00	2.883e+01	2.399e-03	5.150e-02

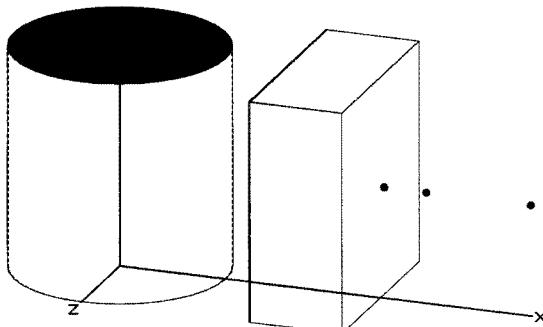
ENGINEERING DESIGN FILE

MicroShield v6.02 (6.02-00061) INEEL

Page : 1
 DOS File : VTANK RX vessel 600 gal decayed 8yr Conc.ms6
 Run Date : September 7, 2004
 Run Time: 10:52:06 AM
 Duration : 00:00:19

File Ref: _____
 Date: _____
 By: _____
 Checked: _____

Case Title: Reaction Vessel
Description: 600 gal of sludge decayed 8 yr w Concrete Shield no Pb
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions			
Height	147.0 cm	4 ft 9.9 in	
Radius	70.104 cm	2 ft 3.6 in	

Dose Points			
# 1	X 175.8318 cm 5 ft 9.2 in	Y 73.5 cm 2 ft 4.9 in	Z 0 cm 0.0 in
# 2	203.7718 cm 6 ft 8.2 in	73.5 cm 2 ft 4.9 in	0 cm 0.0 in
# 3	273.2918 cm 8 ft 11.6 in	73.5 cm 2 ft 4.9 in	0 cm 0.0 in

Shields				
Shield Name	Dimension	Material	Density	
Source	2.27e+06 cm ³	V123 SLUDGE	1.02	
Shield 1	.635 cm	Iron	7.86	
Transition	40.64 cm	Air	0.00122	
Shield 3	.953 cm	Iron	7.86	
Shield 4	60.96 cm	Concrete	2.35	
Air Gap		Air	0.00122	

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Included

Library : Grove

Nuclide	curies	becquerels	$\mu\text{Ci}/\text{cm}^3$	Bq/cm ³
Ac-225	6.5493e-006	2.4232e+005	2.8856e-006	1.0677e-001
Ac-227	5.5480e-009	2.0528e+002	2.4445e-009	9.0446e-005
Ac-228	1.6553e-019	6.1248e-009	7.2935e-020	2.6986e-015
Ag-108	1.3888e-004	5.1386e+006	6.1192e-005	2.2641e+000
Ag-108m	1.4934e-003	5.5254e+007	6.5797e-004	2.4345e+001
Ag-110	1.0991e-008	4.0668e+002	4.8428e-009	1.7918e-004
Ag-110m	8.2642e-007	3.0577e+004	3.6412e-007	1.3473e-002
Am-241	1.6191e-002	5.9906e+008	7.1338e-003	2.6395e+002
Am-243	6.8963e-009	2.5516e+002	3.0385e-009	1.1243e-004
At-217	6.5493e-006	2.4232e+005	2.8856e-006	1.0677e-001
Ba-137m	1.1178e+001	4.1358e+011	4.9250e+000	1.8222e+005
Bi-210	7.4080e-004	2.7409e+007	3.2640e-004	1.2077e+001
Bi-211	5.3923e-009	1.9951e+002	2.3758e-009	8.7906e-005
Bi-212	7.5612e-020	2.7976e-009	3.3315e-020	1.2326e-015
Bi-213	6.5492e-006	2.4232e+005	2.8856e-006	1.0677e-001
Bi-214	3.3677e-003	1.2460e+008	1.4838e-003	5.4901e+001
Ce-144	1.5223e-005	5.6327e+005	6.7075e-006	2.4818e-001
Cm-242	2.6698e-010	9.8782e+000	1.1763e-010	4.3524e-006
Cm-243	3.4656e-003	1.2823e+008	1.5270e-003	5.6498e+001
Cm-244	3.0996e-003	1.1468e+008	1.3657e-003	5.0530e+001
Co-58	1.0513e-015	3.8899e-005	4.6322e-016	1.7139e-011
Co-60	2.3434e-001	8.6704e+009	1.0325e-001	3.8202e+003
Cs-134	1.3111e-004	4.8511e+006	5.7768e-005	2.1374e+000
Cs-137	1.1816e+001	4.3719e+011	5.2061e+000	1.9263e+005
Eu-152	2.2815e-002	8.4415e+008	1.0052e-002	3.7193e+002

Page : 2
DOS File : VTANK RX vessel 600 gal decayed 8yr Conc.ms6
Run Date: September 7, 2004
Run Time: 10:52:06 AM
Duration : 00:00:19

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
Eu-154	3.1419e-002	1.1625e+009	1.3843e-002	5.1220e+002
Eu-155	2.1480e-003	7.9476e+007	9.4641e-004	3.5017e+001
Fr-221	6.5493e-006	2.4232e+005	2.8856e-006	1.0677e-001
Fr-223	7.6562e-011	2.8328e+000	3.3733e-011	1.2481e-006
Gd-152	3.9475e-016	1.4606e-005	1.7393e-016	6.4354e-012
I-129	1.0700e-004	3.9590e+006	4.7144e-005	1.7443e+000
Mn-54	1.5537e-006	5.7487e+004	6.8457e-007	2.5329e-002
Nb-95	2.2789e-016	8.4320e-006	1.0041e-016	3.7152e-012
Nb-95m	8.7397e-019	3.2337e-008	3.8507e-019	1.4248e-014
Ni-63	1.6652e+000	6.1611e+010	7.3367e-001	2.7146e+004
Np-237	5.3442e-005	1.9774e+006	2.3547e-005	8.7123e-001
Np-239	6.8891e-009	2.5490e+002	3.0353e-009	1.1231e-004
Pa-231	4.7366e-008	1.7525e+003	2.0870e-008	7.7217e-004
Pa-233	5.3442e-005	1.9773e+006	2.3546e-005	8.7122e-001
Pa-234	2.4000e-007	8.8800e+003	1.0574e-007	3.9126e-003
Pa-234m	1.5000e-004	5.5500e+006	6.6090e-005	2.4453e+000
Pb-209	6.5487e-006	2.4230e+005	2.8854e-006	1.0676e-001
Pb-210	7.4241e-004	2.7469e+007	3.2711e-004	1.2103e+001
Pb-211	5.3923e-009	1.9951e+002	2.3758e-009	8.7906e-005
Pb-212	7.5618e-020	2.7979e-009	3.3317e-020	1.2327e-015
Pb-214	3.3677e-003	1.2460e+008	1.4838e-003	5.4901e+001
Po-210	6.9531e-004	2.5726e+007	3.0636e-004	1.1335e+001
Po-211	1.4721e-011	5.4467e-001	6.4860e-012	2.3998e-007
Po-212	4.8445e-020	1.7924e-009	2.1345e-020	7.8976e-016
Po-213	6.4077e-006	2.3709e+005	2.8233e-006	1.0446e-001
Po-214	3.3669e-003	1.2458e+008	1.4835e-003	5.4889e+001
Po-215	5.3924e-009	1.9952e+002	2.3759e-009	8.7909e-005
Po-216	7.5673e-020	2.7999e-009	3.3342e-020	1.2336e-015
Po-218	3.3683e-003	1.2463e+008	1.4841e-003	5.4912e+001
Pr-144	1.5224e-005	5.6329e+005	6.7077e-006	2.4819e-001
Pr-144m	2.1770e-007	8.0549e+003	9.5919e-008	3.5490e-003
Pu-238	2.5722e-002	9.5173e+008	1.1333e-002	4.1933e+002
Pu-239	1.3798e-002	5.1052e+008	6.0793e-003	2.2493e+002
Pu-240	1.3791e-002	5.1028e+008	6.0765e-003	2.2483e+002
Ra-223	5.3924e-009	1.9952e+002	2.3759e-009	8.7909e-005
Ra-224	7.5674e-020	2.7999e-009	3.3342e-020	1.2337e-015
Ra-225	6.5820e-006	2.4353e+005	2.9001e-006	1.0730e-001
Ra-226	3.3683e-003	1.2463e+008	1.4841e-003	5.4911e+001
Ra-228	1.6559e-019	6.1269e-009	7.2960e-020	2.6995e-015
Rh-103m	1.0750e-024	3.9775e-014	4.7365e-025	1.7525e-020
Rh-106	8.3308e-005	3.0824e+006	3.6706e-005	1.3581e+000
Rn-219	5.3924e-009	1.9952e+002	2.3759e-009	8.7909e-005
Rn-220	7.5673e-020	2.7999e-009	3.3342e-020	1.2336e-015
Rn-222	3.3683e-003	1.2463e+008	1.4841e-003	5.4912e+001
Ru-103	1.0768e-024	3.9840e-014	4.7443e-025	1.7554e-020
Ru-106	8.3308e-005	3.0824e+006	3.6706e-005	1.3581e+000
Sb-125	1.1063e-003	4.0934e+007	4.8745e-004	1.8036e+001
Sr-90	2.1829e+001	8.0769e+011	9.6181e+000	3.5587e+005
Te-125m	2.7110e-004	1.0031e+007	1.1945e-004	4.4196e+000
Th-227	5.3752e-009	1.9888e+002	2.3683e-009	8.7628e-005
Th-228	7.6135e-020	2.8170e-009	3.3545e-020	1.2412e-015
Th-229	6.6304e-006	2.4533e+005	2.9214e-006	1.0809e-001
Th-230	6.3229e-007	2.3395e+004	2.7859e-007	1.0308e-002
Th-231	2.8000e-004	1.0360e+007	1.2337e-004	4.5646e+000
Th-232	6.4480e-019	2.3857e-008	2.8410e-019	1.0512e-014
Th-234	1.5000e-004	5.5500e+006	6.6090e-005	2.4453e+000
Tl-207	5.3775e-009	1.9897e+002	2.3693e-009	8.7666e-005
Tl-208	2.7168e-020	1.0052e-009	1.1970e-020	4.4289e-016
Tl-209	1.4146e-007	5.2341e+003	6.2329e-008	2.3062e-003
U-233	8.7797e-003	3.2485e+008	3.8684e-003	1.4313e+002

ENGINEERING DESIGN FILE

Page : 3
DOS File : VTANK RX vessel 600 gal decayed 8yr Conc.ms6
Run Date: September 7, 2004
Run Time: 10:52:06 AM
Duration : 00:00:19

<u>Nuclide</u>	<u>curies</u>	<u>becquerels</u>	<u>$\mu\text{Ci}/\text{cm}^3$</u>	<u>Bq/cm^3</u>
U-234	8.7804e-003	3.2488e+008	3.8687e-003	1.4314e+002
U-235	2.8000e-004	1.0360e+007	1.2337e-004	4.5646e+000
U-236	3.2671e-009	1.2088e+002	1.4395e-009	5.3262e-005
U-238	1.5000e-004	5.5500e+006	6.6090e-005	2.4453e+000
Y-90	2.1835e+001	8.0789e+011	9.6206e+000	3.5596e+005
Zn-65	6.3689e-007	2.3565e+004	2.8061e-007	1.0383e-002
Zr-95	1.0309e-016	3.8143e-006	4.5421e-017	1.6806e-012

Buildup
The material reference is : Shield 4

Integration Parameters

Radial	21
Circumferential	21
Y Direction (axial)	21

Results - Dose Point # 1 - (175.8318,73.5,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.144e+09	0.000e+00	1.964e-24	0.000e+00	1.685e-25
0.02	3.632e+07	0.000e+00	2.182e-26	0.000e+00	7.559e-28
0.03	2.441e+10	2.977e-115	3.243e-23	2.950e-117	3.214e-25
0.04	6.502e+09	3.023e-55	2.291e-23	1.337e-57	1.013e-25
0.05	1.928e+08	8.560e-35	2.221e-24	2.280e-37	5.917e-27
0.06	2.183e+08	7.807e-25	5.488e-23	1.551e-27	1.090e-25
0.08	5.901e+07	3.732e-17	2.698e-15	5.905e-20	4.269e-18
0.1	7.924e+08	9.313e-13	1.258e-10	1.425e-15	1.925e-13
0.15	2.263e+06	3.751e-12	8.401e-10	6.177e-15	1.383e-12
0.2	1.834e+08	7.497e-09	1.761e-06	1.323e-11	3.109e-09
0.3	2.741e+08	4.231e-07	7.055e-05	8.027e-10	1.338e-07
0.4	1.717e+08	2.678e-06	2.977e-04	5.219e-09	5.801e-07
0.5	1.448e+07	1.243e-06	9.695e-05	2.439e-09	1.903e-07
0.6	3.724e+11	1.220e-01	7.041e+00	2.382e-04	1.374e-02
0.8	6.701e+08	1.673e-03	5.993e-02	3.181e-06	1.140e-04
1.0	9.429e+09	1.058e-01	2.649e+00	1.951e-04	4.883e-03
1.5	9.344e+09	1.329e+00	1.822e+01	2.236e-03	3.065e-02
2.0	3.335e+07	2.339e-02	2.235e-01	3.617e-05	3.456e-04
3.0	1.003e-09	4.884e-18	2.999e-17	6.626e-21	4.069e-20
TOTALS:	4.299e+11	1.582e+00	2.819e+01	2.708e-03	4.974e-02

Results - Dose Point # 2 - (203.7718,73.5,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Fluence Rate</u> <u>MeV/cm²/sec</u>	<u>Exposure Rate</u> <u>mR/hr</u>	<u>Exposure Rate</u> <u>mR/hr</u>
		<u>No Buildup</u>	<u>With Buildup</u>	<u>No Buildup</u>	<u>With Buildup</u>
0.015	5.144e+09	0.000e+00	1.457e-24	0.000e+00	1.250e-25
0.02	3.632e+07	0.000e+00	1.619e-26	0.000e+00	5.607e-28
0.03	2.441e+10	2.710e-115	2.406e-23	2.686e-117	2.384e-25
0.04	6.502e+09	2.755e-55	1.699e-23	1.219e-57	7.516e-26
0.05	1.928e+08	7.832e-35	1.647e-24	2.086e-37	4.389e-27
0.06	2.183e+08	7.159e-25	4.721e-23	1.422e-27	9.377e-26
0.08	5.901e+07	3.432e-17	2.479e-15	5.430e-20	3.924e-18
0.1	7.924e+08	8.562e-13	1.154e-10	1.310e-15	1.766e-13
0.15	2.263e+06	3.429e-12	7.634e-10	5.647e-15	1.257e-12
0.2	1.834e+08	6.807e-09	1.586e-06	1.201e-11	2.798e-09
0.3	2.741e+08	3.795e-07	6.255e-05	7.198e-10	1.187e-07
0.4	1.717e+08	2.376e-06	2.609e-04	4.630e-09	5.083e-07

ENGINEERING DESIGN FILE

Page : 4
DOS File : VTANK RX vessel 600 gal decayed 8yr Conc.ms6
Run Date: September 7, 2004
Run Time: 10:52:06 AM
Duration : 00:00:19

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>No Buildup</u>	<u>With Buildup</u>	<u>mR/hr</u>
0.5	1.448e+07	1.092e-06	8.411e-05	2.144e-09	1.651e-07
0.6	3.724e+11	1.064e-01	6.057e+00	2.077e-04	1.182e-02
0.8	6.701e+08	1.438e-03	5.083e-02	2.736e-06	9.669e-05
1.0	9.429e+09	8.998e-02	2.222e+00	1.659e-04	4.096e-03
1.5	9.344e+09	1.106e+00	1.497e+01	1.861e-03	2.519e-02
2.0	3.335e+07	1.191e-02	1.811e-01	2.968e-05	2.801e-04
3.0	1.003e-09	3.937e-18	2.391e-17	5.341e-21	3.244e-20
TOTALS:	4.299e+11	1.323e+00	2.348e+01	2.267e-03	4.149e-02

Results - Dose Point # 3 - (273.2918,73.5,0) cm

<u>Energy</u> <u>MeV</u>	<u>Activity</u> <u>photons/sec</u>	<u>Fluence Rate</u>	<u>Fluence Rate</u>	<u>Exposure Rate</u>	<u>Exposure Rate</u>
		<u>MeV/cm²/sec</u>	<u>No Buildup</u>	<u>With Buildup</u>	<u>mR/hr</u>
0.015	5.144e+09	0.000e+00	8.056e-25	0.000e+00	6.910e-26
0.02	3.632e+07	0.000e+00	8.949e-27	0.000e+00	3.100e-28
0.03	2.441e+10	2.147e-115	1.330e-23	2.128e-117	1.318e-25
0.04	6.502e+09	2.216e-55	9.396e-24	9.799e-58	4.155e-26
0.05	1.928e+08	6.310e-35	9.108e-25	1.681e-37	2.426e-27
0.06	2.183e+08	5.748e-25	3.464e-23	1.142e-27	6.880e-26
0.08	5.901e+07	2.707e-17	1.949e-15	4.283e-20	3.084e-18
0.1	7.924e+08	6.633e-13	8.872e-11	1.015e-15	1.357e-13
0.15	2.263e+06	2.580e-12	5.656e-10	4.249e-15	9.313e-13
0.2	1.834e+08	5.022e-09	1.147e-06	8.864e-12	2.024e-09
0.3	2.741e+08	2.721e-07	4.382e-05	5.161e-10	8.312e-08
0.4	1.717e+08	1.668e-06	1.788e-04	3.249e-09	3.484e-07
0.5	1.448e+07	7.534e-07	5.667e-05	1.479e-09	1.112e-07
0.6	3.724e+11	7.235e-02	4.024e+00	1.412e-04	7.855e-03
0.8	6.701e+08	9.558e-04	3.304e-02	1.818e-06	6.285e-05
1.0	9.429e+09	5.874e-02	1.421e+00	1.083e-04	2.619e-03
1.5	9.344e+09	7.001e-01	9.306e+00	1.178e-03	1.566e-02
2.0	3.335e+07	1.191e-02	1.106e-01	1.842e-05	1.710e-04
3.0	1.003e-09	2.388e-18	1.430e-17	3.239e-21	1.941e-20
TOTALS:	4.299e+11	8.441e-01	1.490e+01	1.448e-03	2.637e-02